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# Development Document for Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I.

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Volume I of six volume set which presents data rationale and technical aspects of the final effluent limitations and standards for the iron and steel industry published in the Federal Register on May 27, 1982 (47 FR 23258-317). Volume I describes the general methodology and issues whereas the remaining volumes contain specific subcategory reports.

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# Development Document for Effluent Limitations Guidelines and Standards for the

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## Volume I

## General

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# DEVELOPMENT DOCUMENT

# for

# EFFLUENT LIMITATIONS GUIDELINES

# NEW SOURCE PERFORMANCE STANDARDS

# and

# PRETREATMENT STANDARDS

# for the

# IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY

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## PREFACE

The United States Environmental Protection Agency has promulgated effluent limitations and standards for the steel industry pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act. The regulation contains effluent limitations for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT), as well as pretreatment standards for new and existing sources (PSNS and PSES), and new source performance standards (NSPS).

This Development Document highlights the technical aspects of EPA's study of the steel industry. This volume addresses general issues pertaining to the industry, while the remaining volumes contain specific subcategory reports.

The Agency's economic analysis of the regulation is set forth in a separate document entitled Economic Analysis of Effluent Guidelines - Integrated Iron and Steel Industry. That document is available from the Office of Planning and Evaluation, PM-220, USEPA, Washington, D.C., 20460.

# VOLUME I

# SECTION I

# CONCLUSIONS

1. Total process water usage in the steel industry is about 5,740,000,000 (5740 MGD) gallons per day. The untreated process wastewaters contain about 43,600 tons/year of toxic organic pollutants, 121,900 tons/year of toxic inorganic pollutants, and 14,500,000 tons/year of conventional and nonconventional pollutants. Steel industry process wastewaters are treatable by currently available, practicable and economically achievable control and treatment technologies.

2. The Regulation contains limitations and standards for process wastewaters generated in the different subcategories, subdivisions and segments of the industry. The subcategorization is based primarily upon differences in wastewater quantity and quality related to differences in industry manufacturing processes. The Agency has adopted a revised subcategorization of the industry from that used in prior regulations to more accurately effect production operations in the industry, and, to simplify the use of the regulation. The subcategorization of the industry in this fashion does not affect the substantive requirements of the regulation. The Regulation applies to the 12 subcategories of the steel industry, their subdivisions, and segments as shown below:

| Subpart/Subcategory | Subdivision | Segment |
|---|---|---|
| A. Cokemaking | By-Product | Iron and Steel<br>Merchant |
| | Beehive | - |
| B. Sintering | - | - |
| C. Ironmaking | Iron Blast Furnace<br>Ferromanganese Blast Furnace | - |
| D. Steelmaking | Basic Oxygen Furnace | Semi-Wet<br>Wet-Suppressed Combustion<br>Wet-Open Combustion |
| | Open Hearth Furnace | Wet |
| | Electric Arc Furnace | Semi-Wet |

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| | | Wet |
|---|---|---|
| E. Vacuum Degassing | - | - |
| F. Continuous Casting | - | - |
| G. Hot Forming | Primary | Carbon and Specialty Mills without Scarfers |
| | | Carbon and Specialty Mills with Scarfers |
| | Section | Carbon Mills |
| | | Specialty Mills |
| | Flat | Hot Strip and Sheet Mills |
| | | Carbon Plate Mills |
| | | Specialty Plate Mills |
| | Pipe & Tube Mills | - |
| H. Salt Bath Descaling | Oxidizing | Batch: Sheet, Plate |
| | | Batch: Rod, Wire, Bar |
| | | Batch: Pipe, Tube |
| | | Continuous |
| | Reducing | Batch |
| | | Continuous |
| I. Acid Pickling | Sulfuric Acid | Rod, Wire, Coil |
| | | Bar, Billet, Bloom |
| | | Strip, Sheet, Plate |
| | | Pipe, Tube, Other |
| | | Fume Scrubber |
| | Hydrochloric Acid | Rod, Wire, Coil |
| | | Strip, Sheet, Plate |
| | | Pipe, Tube, Other |
| | | Fume Scrubber |
| | | Acid Regeneration |
| | Combination Acid | Rod, Wire, Coil |
| | | Bar, Billet, Bloom |
| | | Strip, Sheet, Plate-Continuous |
| | | Strip, Sheet, Plate-Batch |
| | | Pipe, Tube, Other |
| | | Fume Scrubber |

| | | |
|---|---|---|
| J. Cold Forming | Cold Rolling | Recirculation:<br>Single Stand<br>Multi-Stand<br>Combination<br>Direct Application:<br>Single-Stand<br>Multi-Stand |
| | Cold Worked Pipe & Tube | Water Solutions<br>Oil Solutions |
| K. Alkaline Cleaning | Batch | - |
| | Continuous | - |
| L. Hot Coating | Galvanizing, Terne and Other Metal Coatings | Strip, Sheet, and Miscellaneous Products<br>Wire Products and Fasteners |
| | Fume Scrubbers | - |

## 3. Best Practicable Control Technology Currently Available (BPT)

For the most part, the BPT limitations for the basic steelmaking operations (cokemaking, sintering, ironmaking, steelmaking, vacuum degassing, and continuous casting) are the same as those contained in the prior regulations and those proposed in January 1981, (46 FR 1858). Where the BPT limitations for the basic steelmaking operations are different than those proposed, the changes are the result of the Agency's evaluation and response to comments received during the public comment period for the proposed regulation. The major changes are summarized below:

A. Cokemaking

The total suspended solids limitations were relaxed to reflect actual operations of biological treatment systems used to treat cokemaking wastewaters. Separate limitations are promulgated for merchant cokemaking operations.

B. Sintering

The limitations were relaxed to reflect a higher model treatment system effluent flow rate.

C. Ironmaking

None

D. Steelmaking

The limitations for the BOF wet-open combustion and EAF-Wet segments were relaxed to reflect higher model treatment system effluent flow rates. The Open Hearth semi-wet segment was deleted.

E. Vacuum Degassing

None

F. Continuous Casting

None

Many of the BPT effluent limitations for the forming and finishing operations (hot forming, descaling, cold rolling, acid pickling, alkaline cleaning, and hot coating) were changed. Some of the final limitations are more stringent than those proposed and some are less stringent. These changes result partly from revised segmentation and subdivision of certain subcategories and partly from the Agency's re-assessment of its existing data base and additional data received during the public comment period for the proposed regulation. In all cases, however, the basic technologies underlying the BPT limitations have remained the same. The model treatment system flow rates and effluent quality were changed to reflect actual flows in the industry and the performance of properly designed and operated treatment systems. In all cases, the Agency believes the changes made have resulted in more appropriate, technically sound limitations. These changes are summarized below:

G. Hot Forming

The model treatment system flow rates and effluent quality were revised to reflect actual performance of the model treatment systems.

H. Salt Bath Descaling

The subcategory was resegmented to provide more appropriate rinsewater flows by product and by type of operation. Limitations were promulgated for suspended solids, chromium, nickel, and pH.

I. Acid Pickling

The subcategory was resegmented to provide more appropriate rinsewater flows by product. Separate daily mass limitations were promulgated for fume scrubbers and for regeneration system absorber vent scrubbers. Lead and zinc are limited for sulfuric and hydrochloric acid pickling operations and chromium and nickel are limited for combination acid pickling operations.

J. Cold Forming

Separate limitations were promulgated for single stand recirculation and direct application cold rolling mills. Lead and zinc are limited for cold rolling operations processing carbon steels and chromium and nickel are limited for cold rolling operations processing specialty steels. Limitations for naphthalene and tetrachloroethylene are provided for all cold rolling operations. There are no changes to the BPT limitations for cold worked pipe and tube operations.

K. Alkaline Cleaning

The limitations were relaxed to reflect higher model treatment system effluent flow rates.

L. Hot Coating

Separate daily mass limitations were promulgated for fume scrubbers. Limitations were promulgated for lead and zinc for all hot coating operations. Chromium limitations are promulgated for those hot coating operations with chromate rinse operations.

The model treatment system flow rates and effluent quality used to develop the BPT limitations are presented in Table I-1. Comparisons of the BPT limitations contained in prior regulations with the promulgated BPT limitations are presented in Table I-2.

4. Best Available Technology Economically Achievable (BAT)

The BAT limitations for the basic steelmaking operations are generally based upon the same treatment technologies as the proposed limitations. However, in several cases, the limitations were changed based upon comments and data received as a result of the public comment period. In some cases, different model treatment technologies were used to develop the limitations. The more significant changes are summarized below:

A. Cokemaking

The limitations for ammonia-N, cyanide, and phenols (4AAP) were relaxed to a minor extent based upon a review of extensive data for the model treatment system. Only daily maximum limitations for benzene, benzo(a)pyrene, and naphthalene are promulgated. Separate limitations are promulgated for merchant cokemaking operations.

B. Sintering

The model treatment system effluent flow rate was relaxed to reflect achievable wastewater recycle rates for sintering operations with wet air pollution control systems on all parts of the process. The selected model treatment technology is filtration as opposed to alkaline chlorination. However, limitations for ammonia-N, total cyanide, and phenols (4AAP) were promulgated for those sintering operations with wastewaters co-treated with ironmaking wastewaters.

C. Ironmaking

The ammonia-N limitation was significantly relaxed to take into account full scale operation of the selected model treatment technology.

D. Steelmaking

The model treatment system was changed by deleting the final effluent filter and the limitations were adjusted accordingly. Only limitations for lead and zinc were promulgated. Limitations for chromium were proposed.

E.,F. Vacuum Degassing, Continuous Casting

The model treatment systems were changed from filtration to lime precipitation and sedimentation to address treatment of dissolved toxic metals. The promulgated limitations for lead and zinc are consistent with those for steelmaking operations.

G. Hot Forming

BAT limitations are not promulgated for hot forming operations. The Agency has determined that the BPT model treatment system provides sufficient control of toxic metals.

H.,I.,J. Salt Bath Descaling, Acid Pickling, Cold Forming

BAT limitations more stringent than the promulgated BPT limitations were not promulgated for descaling, acid pickling, and cold forming operations.

K. Alkaline Cleaning

None

L. Hot Coating

For those operations with fume scrubbers, BAT limitations based upon recycle of fume scrubber wastewaters and the BPT model treatment system were promulgated. For those operations without fume scrubbers, BAT limitations more stringent than the respective BPT limitations were not promulgated.

The model treatment system effluent flow rates and effluent quality used to develop the BAT limitations are presented in Table I-3. The BAT limitations are presented in Table I-4.

5. New Source Performance Standards (NSPS)

In all cases, the promulgated NSPS are based upon the same basic technologies used to develop the BPT and BAT limitations. In several instances, NSPS more stringent than the respective BPT and BAT limitations were promulgated based upon more stringent model treatment system discharge flow rates demonstrated in the industry. The development of NSPS is set out in each subcategory report. The model treatment system effluent flow rates and effluent quality used to develop NSPS are presented in Table I-5. The NSPS are presented in Table I-6.

6. Pretreatment Standards (PSES and PSNS)

The promulgated pretreatment standards are designed to minimize pass through of toxic pollutants discharged to POTWs from steel industry operations. Except for cokemaking operations, the promulgated PSES and PSNS are' the same as the respective BAT limitations and NSPS. For cokemaking operations, PSES and PSNS are based upon the same pretreatment the industry provides for on-site biological treatment of cokemaking wastewaters. The model treatment system effluent flow rates and the effluent quality used to develop the PSES are presented in Table I-7. The PSES are presented in Table I-8. The same information for PSNS and the PSNS are presented in Tables I-5 and I-6, respectively.

7. Best Conventional Technology (BCT)

As a result of the remand of the Agency's BCT costing methodology in API vs EPA [660 F.2d 954 (4th Cir. 1981)] the Agency has reserved BCT limitations in those subcategories where the model BAT treatment technologies provide for conventional pollutant removal beyond that provided by the model BPT technologies (sintering, ironmaking, steelmaking, vacuum degassing, continuous casting). For the remaining subcategories, the Agency has promulgated BCT limitations that are the same as the respective BPT limitations.

The model treatment system flow rates and effluent quality used to develop the BCT limitations are presented in Table I-9. The BCT limitations are presented in Table I-10.

8. The Agency concludes that the effluent reduction benefits associated with compliance with the regulation will result in significant removals of toxic, conventional and other pollutants.

Table I-11 presents a summary of the effluent reduction benefits associated with this regulation on an industry-wide basis. Table I-12 and I-13 present summaries for direct and indirect dischargers, respectively.

The Agency concludes that the effluent reduction benefits associated with compliance with both existing and new source limitations and standards outweigh the minor adverse energy and non-water quality environmental impacts.

9. The Agency estimates that based upon production and treatment facilities in place as of July 1, 1981, the industry will incur the following costs to comply with the regulation. The Agency has determined that the effluent reduction benefits associated with compliance with the limitations and standards outweigh the costs of compliance.

Costs (Millions of July 1, 1978 Dollars)

| | Capital Costs | | | Total |
|---|---|---|---|---|
| | Total | In-place | Required | Annual |
| BPT | 1697 | 1491 | 206 | 204 |
| BAT | 101 | 24 | 77 | 24 |
| PSES | 173 | 132 | 41 | 31 |
| TOTAL | 1971 | 1647 | 324 | 259 |

Table I-14 presents these costs by subcategory. The Agency has also determined that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) justify the associated costs.

The industry production capacity profile used in this study differs slightly from that used in the preparation of Economic Analysis of Proposed Effluent Guidelines - Integrated Iron and Steel Industry which reviews in detail the potential economic impact of this regulation. The capacity profile used in that analysis is based upon information obtained from AISI and includes predictions of future retirements, modernization, and reworks over the next ten years, whereas this development document has focused on the industry as it now exists and the extent to which pollution control technologies are demonstrated.

10. With respect to the general issues remanded by the United States Court of Appeals for the Third Circuit, the Agency concluded:

    a. The "age" of facilities has no significant impact on the "cost or feasibility of retrofitting" pollution controls. First, "age" is a relatively meaningless term in the steel industry. It is extremely difficult to define because many plants are continually rebuilt and modernized.

Whether "first year of production" or "years since last rebuild" is taken as an indicia of plant "age", the data show that "age" has no significant impact on the "feasibility" of retrofitting. Many "old" facilities are served by modern and efficient retrofitted treatment systems. With regard to the impact of plant "age" on the cost of retrofitting, most respondents to EPA questionnaires were unable to estimate "retrofit" costs, reported no retrofit costs, or reported retrofit costs of less than 5% of pollution control costs. The Agency compared its model based cost estimates with actual industry costs for over 90 installed treatment facilities, many of which were retrofitted to older production facilities. The Agency found that the model based cost estimates are sufficiently generous to account for retrofit costs at both older and newer plants. Also, detailed engineering studies and industry cost estimates for three of the "oldest" plants in the country produced cost estimates similar to EPA's model plant estimates.

The Agency found that both old and newer facilities generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within each subcategory on the basis of age is not appropriate.

However, even assuming that plant "age" does affect the "cost or feasibility of retrofitting," EPA believes that separate subcategorization or relaxed limitations for "older" plants are not justifiable. "Older" plants cause similar pollution problems as "newer" plants, and the need to control these problems would justify the expenditure of reasonable, if any, additional "retrofit" costs. Therefore the regulation does not differentiate between "old" and "new" facilities.

b. The Agency's cost estimates are sufficiently generous to reflect all costs to be incurred when installing wastewater treatment systems, including "site-specific costs". The Agency's cost models now include several "site-specific cost" items not included in prior cost models (See Sections III and VII) and incorporate several conservative assumptions. As noted above, the Agency also compared its model plant cost estimates with actual costs reported by the industry including "site-specific costs." Finally, detailed plant-by-plant engineering estimates (cost estimates provided by the industry) for eight plants reveal estimated costs (including "site-specific costs") similar to EPA's model plant cost estimates.

c. The BPT and BAT limitations and the PSES, PSNS, and NSPS in seven subcategories are based upon model treatment systems including recycle systems and mechanical draft cooling towers. The installation of these systems may result in evaporative water losses of about 4.2 MGD above current losses (16.0 MGD). However, the environmental benefits of these treatment systems justify the additional evaporative water losses. Recycle and cooling systems are extensively used at steel plants in water-scarce areas and the Agency concludes that the incremental impacts of the regulation on these plants is either minimal or nonexistent.

11. Table I-15 presents a summary, by subcategory, of the water pollution control and treatment technologies considered by the Agency in developing the limitations and standards.

# TABLE I-1

## BPT CONCENTRATION AND FLOW SUMMARY
## IRON AND STEEL INDUSTRY

| | | | BPT Effluent Concentrations (mg/l) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Toxic Organics | |
| Subcategory | | Discharge Flow (GPT) | TSS | O&G | Ammonia | Phenol (4AAP) | CN-T | $Cr^{+6}$ | Cr | Ni | Pb | Zn | 55 | 85 |
| Cokemaking | | | | | | | | | | | | | | |
| Iron & Steel | Avg | 225 | 140 | 11.6 | 97.2 | 1.6 | 23.3 | | | | | | | |
| | Max | | 270 | 34.8 | 292 | 4.8 | 70.0 | | | | | | | |
| Merchant | Avg | 240 | 140 | 11.6 | 97.2 | 1.6 | 23.3 | | | | | | | |
| | Max | | 270 | 34.8 | 292 | 4.8 | 70.0 | | | | | | | |
| Beehive | Avg | 0 | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Sintering | Avg | 120 | 50 | 10 | | | | | | | | | | |
| | Max | | 150 | 30 | | | | | | | | | | |
| Ironmaking | | | | | | | | | | | | | | |
| Iron | Avg | 125 | 50 | | 103 | 4.0 | 15.0 | | | | | | | |
| | Max | | 150 | | 309 | 12.0 | 45.0 | | | | | | | |
| Ferromanganese | Avg | 250 | 100 | | 410 | 20.0 | 150 | | | | | | | |
| | Max | | 300 | | 1240 | 60.0 | 450 | | | | | | | |
| Steelmaking | | | | | | | | | | | | | | |
| BOF:Semi-Wet | Avg | 0 | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| BOF:Wet-Open Combustion | Avg | 110 | 50 | | | | | | | | | | | |
| | Max | | 150 | | | | | | | | | | | |
| BOF: Wet-Suppressed Combustion | Avg | 50 | 50 | | | | | | | | | | | |
| | Max | | 150 | | | | | | | | | | | |
| Open Hearth-Wet | Avg | 110 | 50 | | | | | | | | | | | |
| | Max | | 150 | | | | | | | | | | | |
| Electric Arc Furnace:Semi-Wet | Avg | 0 | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Electric Arc Furnace:Wet | Avg | 110 | 50 | | | | | | | | | | | |
| | Max | | 150 | | | | | | | | | | | |
| Vacuum Degassing | Avg | 25 | 50 | | | | | | | | | | | |
| | Max | | 150 | | | | | | | | | | | |

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

| Subcategory | | Discharge Flow (GPT) | BPT Effluent Concentrations (mg/l) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSS | O&G | Ammonia | Phenol (4AAP) | CN-T | $Cr^{+6}$ | Cr | Ni | Pb | Zn | Toxic Organics | |
| | | | | | | | | | | | | | 55 | 85 |
| Continuous Casting | Avg | 125 | 50 | 15 | | | | | | | | | | |
| | Max | | 150 | 45 | | | | | | | | | | |
| Hot Forming | | | | | | | | | | | | | | |
| Primary: Carbon & Spec w/o scarf. | Avg | 897 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Primary:Carbon & Spec w/scarf. | Avg | 1326 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Section:Carbon | Avg | 2142 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Section:Specialty | Avg | 1344 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Flat:Hot Strip & Sheet (Carbon & Specialty) | Avg | 2560 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Flat:Plate-Carbon | Avg | 1360 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Flat:Plate-Spec. | Avg | 600 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Pipe & Tube | Avg | 1270 | 15 | - | | | | | | | | | | |
| | Max | | 40 | 10 | | | | | | | | | | |
| Salt Bath Descaling | | | | | | | | | | | | | | |
| Oxidizing-Batch, Sheet & Plate | Avg | 700 | 30 | | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | | | | | | 1.0 | 0.9 | | | | |
| Oxidizing-Batch Rod & Wire | Avg | 420 | 30 | | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | | | | | | 1.0 | 0.9 | | | | |
| Oxidizing-Batch Pipe & Tube | Avg | 1700 | 30 | | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | | | | | | 1.0 | 0.9 | | | | |
| Oxidizing-Cont. | Avg | 330 | 30 | | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | | | | | | 1.0 | 0.9 | | | | |

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

| Subcategory | | Discharge Flow (GPT) | BPT Effluent Concentrations (mg/l) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSS | O&G | Ammonia | Phenol (4AAP) | CN-T | Cr+6 | Cr | Ni | Pb | Zn | Toxic Organics 55 | Toxic Organics 85 |
| **Salt Bath Descal. (Cont.)** | | | | | | | | | | | | | | |
| Reducing-Batch | Avg | 325 | 30 | | | | 0.25 | | 0.4 | 0.3 | | | | |
| | Max | | 70 | | | | 0.75 | | 1.0 | 0.9 | | | | |
| Reducing-Cont. | Avg | 1820 | 30 | | | | 0.25 | | 0.4 | 0.3 | | | | |
| | Max | | 70 | | | | 0.75 | | 1.0 | 0.9 | | | | |
| **Sulfuric Acid Pickling** | | | | | | | | | | | | | | |
| Strip, Sheet & Plate | Avg | 180 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Rod, Wire & Coil | Avg | 280 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Bar, Billet & Bloom | Avg | 90 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Pipe, Tube & Other | Avg | 500 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Fume Scrubber(2) | Avg | 15 GPM | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| **HCl Acid Pickling** | | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 490 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Strip, Sheet & Plate | Avg | 280 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Pipe, Tube & Other | Avg | 1020 | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Fume Scrubber(2) | Avg | 15 GPM | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| Acid Regeneration | Avg | 100 GPM | 30 | 10(1) | | | | | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30(1) | | | | | | | 0.45 | 0.3 | | |
| **Comb. Acid Pickling** | | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 510 | 30 | 10(1) | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | 30(1) | | | | | 1.0 | 0.9 | | | | |
| Bar, Billet & Bloom | Avg | 230 | 30 | 10(1) | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | 30(1) | | | | | 1.0 | 0.9 | | | | |

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 4

| Subcategory | | Discharge Flow (GPT) | BPT Effluent Concentrations (mg/l) | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSS | O&G | Ammonia | Phenol (4AAP) | CN-T | $Cr^{+6}$ | Cr | Ni | Pb | Zn | 55 | 85 |
| Comb. Acid Pickling (Cont.) | | | | | | | | | | | | | | |
| Cont.-Strip, Sheet | Avg | 1500 | 30 | $10^{(1)}$ | | | | | 0.4 | 0.3 | | | | |
| & Plate | Max | | 70 | $30^{(1)}$ | | | | | 1.0 | 0.9 | | | | |
| Batch-Strip, Sheet | Avg | 460 | 30 | $10^{(1)}$ | | | | | 0.4 | 0.3 | | | | |
| & Plate | Max | | 70 | $30^{(1)}$ | | | | | 1.0 | 0.9 | | | | |
| Pipe, Tube & Other | Avg | 770 | 30 | $10^{(1)}$ | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | $30^{(1)}$ | | | | | 1.0 | 0.9 | | | | |
| Fume Scrubber$^{(2)}$ | Avg | 15 GPM | 30 | $10^{(1)}$ | | | | | 0.4 | 0.3 | | | | |
| | Max | | 70 | $30^{(1)}$ | | | | | 1.0 | 0.9 | | | | |
| Cold Forming | | | | | | | | | | | | | | |
| Cold Rolling: Recir | Avg | 5 | 30 | 10 | | | | | $0.4^{(3)}$ | $0.3^{(3)}$ | 0.15 | 0.1 | - | - |
| Single Stand | Max | | 60 | 25 | | | | | $1.0^{(3)}$ | $0.9^{(3)}$ | 0.45 | 0.3 | 0.1 | 0.15 |
| Cold Rolling: Recir | Avg | 25 | 30 | 10 | | | | | $0.4^{(3)}$ | $0.3^{(3)}$ | 0.15 | 0.1 | - | - |
| Multi Stand | Max | | 60 | 25 | | | | | $1.0^{(3)}$ | $0.9^{(3)}$ | 0.45 | 0.3 | 0.1 | 0.15 |
| Cold Rolling: | Avg | 300 | 30 | 10 | | | | | $0.4^{(3)}$ | $0.3^{(3)}$ | 0.15 | 0.1 | - | - |
| Combination | Max | | 60 | 25 | | | | | $1.0^{(3)}$ | $0.9^{(3)}$ | 0.45 | 0.3 | 0.1 | 0.15 |
| Cold Rolling: Direct | Avg | 90 | 30 | 10 | | | | | $0.4^{(3)}$ | $0.3^{(3)}$ | 0.15 | 0.1 | - | - |
| Appl. Single Stand | Max | | 60 | 25 | | | | | $1.0^{(3)}$ | $0.9^{(3)}$ | 0.45 | 0.3 | 0.1 | 0.15 |
| Cold Rolling: Direct | Avg | 400 | 30 | 10 | | | | | $0.4^{(3)}$ | $0.3^{(3)}$ | 0.15 | 0.1 | - | - |
| Appl. Multi Stand | Max | | 60 | 25 | | | | | $1.0^{(3)}$ | $0.9^{(3)}$ | 0.45 | 0.3 | 0.1 | 0.15 |
| Pipe & Tube | Avg | 0 | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Alkaline Cleaning | | | | | | | | | | | | | | |
| Batch | Avg | 250 | 30 | 10 | | | | | | | | | | |
| | Max | | 70 | 30 | | | | | | | | | | |
| Continuous | Avg | 350 | 30 | 10 | | | | | | | | | | |
| | Max | | 70 | 30 | | | | | | | | | | |

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 5

| Subcategory | | Discharge Flow (GPT) | BPT Effluent Concentrations (mg/l) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSS | O&G | Ammonia | Phenol (4AAP) | CN-T | $Cr^{+6}$ | Cr | Ni | Pb | Zn | Toxic Organics 55 | Toxic Organics 85 |
| Hot Coating - (Includes all coating operations) | | | | | | | | | | | | | | |
| Strip/Sheet/Misc. wo/ Scrubbers | Avg | 600 | 30 | 10 | | | | $0.02^{(4)}$ | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30 | | | | $0.06^{(4)}$ | | | 0.45 | 0.3 | | |
| Wire Fasteners wo/ Scrubbers | Avg | 2400 | 30 | 10 | | | | $0.02^{(4)}$ | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30 | | | | $0.06^{(4)}$ | | | 0.45 | 0.3 | | |
| Fume Scrubbers(2) | Avg | 100 GPM | 30 | 10 | | | | $0.02^{(4)}$ | | | 0.15 | 0.1 | | |
| | Max | | 70 | 30 | | | | $0.06^{(4)}$ | | | 0.45 | 0.3 | | |

NOTE: pH is also regulated in all subcategories and is limited to 6.0 to 9.0 standard units.

(1): This pollutant is regulated only when these wastes are treated in combination with cold rolling mill wastes.
(2): The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
(3): This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(4): This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-2

BPT EFFLUENT LIMITATIONS COMPARISON
IRON & STEEL INDUSTRY

| | | | BPT Effluent Limitations (kg/kkg x $10^{-5}$) | | | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory | | Discharge Flow (GPT) | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | 55 | 85 |
| Cokemaking | | | | | | | | | | | | | | | | |
| Iron & Steel | 1976 Avg | 175 | 3650 | 1090 | 912 | 146 | | 2190 | | | | | | | | |
| | Max | | 11000 | 3290 | 2740 | 438 | | 6570 | | | | | | | | |
| | Rev. Avg | 225 | 13100 | 1090 | 9120 | 150 | | 2190 | | | | | | | | |
| | Max | | 25300 | 3270 | 27400 | 451 | | 6570 | | | | | | | | |
| Merchant | 1976 Avg | No Separate Limitations Proposed for this Segment | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | 240 | 14000 | 1160 | 9730 | 160 | | 2330 | | | | | | | | |
| | Max | | 27000 | 3480 | 29200 | 481 | | 7010 | | | | | | | | |
| Beehive | 1976 Avg | 0 | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | No Change | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Sintering | 1976 Avg | 50 | 1040 | 209 | | | | | | | | | | | | |
| | Max | | 3130 | 626 | | | | | | | | | | | | |
| | Rev. Avg | 120 | 2500 | 501 | | | | | | | | | | | | |
| | Max | | 7510 | 1500 | | | | | | | | | | | | |
| Ironmaking | | | | | | | | | | | | | | | | |
| Iron | 1976 Avg | 125 | 2600 | | 5370 | 209 | | 782 | | | | | | | | |
| | Max | | 7820 | | 16100 | 626 | | 2340 | | | | | | | | |
| | Rev. Avg | No Change | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Ferromanganese | 1976 Avg | 250 | 10400 | | 42900 | 2080 | | 15600 | | | | | | | | |
| | Max | | 31300 | | 128000 | 6240 | | 46900 | | | | | | | | |
| | Rev. Avg | No Change | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Steelmaking | | | | | | | | | | | | | | | | |
| BOF: Semi-Wet | 1976 Avg | 0 | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | No Change | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| BOF: Wet-Supp. | 1976 Avg | 50 | 1040 | | | | | | | | | | | | | |
| | Max | | 3130 | | | | | | | | | | | | | |
| | Rev. Avg | No Change | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| BOF: Wet-Open | 1976 Avg | 50 | 1040 | | | | | | | | | | | | | |
| | Max | | 3130 | | | | | | | | | | | | | |
| | Rev. Avg | 110 | 2290 | | | | | | | | | | | | | |
| | Max | | 6880 | | | | | | | | | | | | | |
| Open Hearth: Semi-Wet | 1976 Avg | 50 | 1040 | | | | | | | | | | | | | |
| | Max | | 3130 | | | | | | | | | | | | | |
| | Rev. Avg | Segment Eliminated | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 2

| Subcategory | | | Discharge Flow (GPT) | BPT Effluent Limitations (kg/kkg x $10^{-5}$) | | | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | 55 | 85 |
| Open Hearth: Wet | 1976 | Avg | 50 | 1040 | | | | | | | | | | | | | |
| | | Max | | 3130 | | | | | | | | | | | | | |
| | Rev. | Avg | 110 | 2290 | | | | | | | | | | | | | |
| | | Max | | 6880 | | | | | | | | | | | | | |
| EAF: Semi-Wet | 1976 | Avg | 0 | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | No Change | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| EAF: Wet | 1976 | Avg | 50 | 1040 | | | | | | | | | | | | | |
| | | Max | | 3130 | | | | | | | | | | | | | |
| | Rev. | Avg | 110 | 2290 | | | | | | | | | | | | | |
| | | Max | | 6880 | | | | | | | | | | | | | |
| Vacuum Degassing | 1976 | Avg | 25 | 522 | | | | | | | | | | | | | |
| | | Max | | 1560 | | | | | | | | | | | | | |
| | Rev. | Avg | No Change | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Continuous Casting | 1976 | Avg | 125 | 2600 | 780 | | | | | | | | | | | | |
| | | Max | | 7800 | 2340 | | | | | | | | | | | | |
| | Rev. | Avg | No Change | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Hot Forming | | | | | | | | | | | | | | | | | |
| Prim.-Carbon w/s | 1976 | Avg | 845 | 4530 | 3520 | | | | | | | | | | | | |
| | | Max | | 13600 | 10600 | | | | | | | | | | | | |
| | Rev. | Avg | 1326 | 8300 | - | | | | | | | | | | | | |
| | | Max | | 22100 | 5530 | | | | | | | | | | | | |
| Prim.-Carbon wo/s | 1976 | Avg | 692 | 3710 | 2880 | | | | | | | | | | | | |
| | | Max | | 11100 | 8640 | | | | | | | | | | | | |
| | Rev. | Avg | 897 | 5610 | - | | | | | | | | | | | | |
| | | Max | | 15000 | 3740 | | | | | | | | | | | | |
| Prim.-Spec. w/s | 1976 | Avg | 1220 | 6540 | 5080 | | | | | | | | | | | | |
| | | Max | | 19600 | 15200 | | | | | | | | | | | | |
| | Rev. | Avg | 1326 | 8300 | - | | | | | | | | | | | | |
| | | Max | | 22100 | 5530 | | | | | | | | | | | | |
| Prim.-Spec. wo/s | 1976 | Avg | 1220 | 6540 | 5080 | | | | | | | | | | | | |
| | | Max | | 19600 | 15200 | | | | | | | | | | | | |
| | Rev. | Avg | 897 | 5610 | - | | | | | | | | | | | | |
| | | Max | | 15000 | 3740 | | | | | | | | | | | | |
| Section-Carbon | 1976 | Avg | 2626 | 24200 | 11000 | | | | | | | | | | | | |
| | | Max | | 72600 | 33000 | | | | | | | | | | | | |
| | Rev. | Avg | 2142 | 13400 | - | | | | | | | | | | | | |
| | | Max | | 35700 | 8940 | | | | | | | | | | | | |

TABLE 1-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 3

| Subcategory | | | Dis-charge Flow (GPT) | BPT Effluent Limitations (kg/kkg x $10^{-5}$) TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | Toxic Organics 55 | Toxic Organics 85 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section-Spec. | 1976 | Avg | 2626 | 24200 | 11000 | | | | | | | | | | | | |
| | | Max | | 72600 | 33000 | | | | | | | | | | | | |
| | Rev. | Avg | 1344 | 8410 | - | | | | | | | | | | | | |
| | | Max | | 22400 | 5610 | | | | | | | | | | | | |
| Flat-Carbon HS&S | 1976 | Avg | 4180 | 33100 | 17400 | | | | | | | | | | | | |
| | | Max | | 99800 | 52200 | | | | | | | | | | | | |
| | Rev. | Avg | 2560 | 16000 | - | | | | | | | | | | | | |
| | | Max | | 42700 | 10700 | | | | | | | | | | | | |
| Flat-Spec. HS&S | 1976 | Avg | 4180 | 33100 | 17400 | | | | | | | | | | | | |
| | | Max | | 99300 | 52200 | | | | | | | | | | | | |
| | Rev. | Avg | 2560 | 16000 | - | | | | | | | | | | | | |
| | | Max | | 42700 | 10700 | | | | | | | | | | | | |
| Flat-Carbon Plate | 1976 | Avg | 4000 | 16700 | 16700 | | | | | | | | | | | | |
| | | Max | | 50100 | 50100 | | | | | | | | | | | | |
| | Rev. | Avg | 1360 | 8510 | - | | | | | | | | | | | | |
| | | Max | | 22700 | 5670 | | | | | | | | | | | | |
| Flat-Spec. Plate | 1976 | Avg | 9366 | 37600 | 37600 | | | | | | | | | | | | |
| | | Max | | 113000 | 113000 | | | | | | | | | | | | |
| | Rev. | Avg | 600 | 3750 | - | | | | | | | | | | | | |
| | | Max | | 10000 | 2500 | | | | | | | | | | | | |
| Pipe & Tube-Carbon | 1976 | Avg | 1002 | 14200 | 4180 | | | | | | | | | | | | |
| | | Max | | 42600 | 12500 | | | | | | | | | | | | |
| | Rev. | Avg | 1270 | 7950 | - | | | | | | | | | | | | |
| | | Max | | 21200 | 5300 | | | | | | | | | | | | |
| Pipe & Tube-Spec. | 1976 | Avg | 1002 | 14200 | 4180 | | | | | | | | | | | | |
| | | Max | | 42600 | 12500 | | | | | | | | | | | | |
| | Rev. | Avg | 1270 | 7950 | - | | | | | | | | | | | | |
| | | Max | | 21200 | 5300 | | | | | | | | | | | | |
| Salt Bath Descaling | | | | | | | | | | | | | | | | | |
| Ox.-Batch S&P(1) | 1976 | Avg | 500 | 5210 | | | | 209 | 52.1 | 10.4 | 104* | | | | | | |
| | | Max | | 15600 | | | | 627 | 156 | 31.3 | 313* | | | | | | |
| | Rev. | Avg | 700 | 8760 | | | | | | | 117 | 87.6 | | | | | |
| | | Max | | 20400 | | | | | | | 292 | 263 | | | | | |
| Ox.-Batch R/W/B(1) | 1976 | Avg | 500 | 5210 | | | | 209 | 52.1 | 10.4 | 104* | | | | | | |
| | | Max | | 15600 | | | | 627 | 156 | 31.3 | 313* | | | | | | |
| | Rev. | Avg | 420 | 5260 | | | | | | | 70.1 | 52.6 | | | | | |
| | | Max | | 12300 | | | | | | | 175 | 158 | | | | | |
| Ox.-Batch P&T(1) | 1976 | Avg | 500 | 5210 | | | | 209 | 52.1 | 10.4 | 104* | | | | | | |
| | | Max | | 15600 | | | | 627 | 156 | 31.3 | 313* | | | | | | |
| | Rev. | Avg | 1700 | 21300 | | | | | | | 284 | 213 | | | | | |
| | | Max | | 49600 | | | | | | | 709 | 638 | | | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
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| Subcategory | | | Dis-charge Flow (GPT) | BPT Effluent Limitations (kg/kkg x $10^{-5}$) TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | Toxic Organics 55 | Toxic Organics 85 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ox.-Cont.(1) | 1976 | Avg | 500 | 5210 | | | | 209 | 52.1 | 10.4 | 104* | | | | | | |
| | | Max | | 15600 | | | | 627 | 156 | 31.3 | 313* | | | | | | |
| | Rev. | Avg | 330 | 4130 | | | | | | | 55.1 | 41.3 | | | | | |
| | | Max | | 9640 | | | | | | | 138 | 124 | | | | | |
| Red.-Batch(2) | 1976 | Avg | 1200 | 12500 | | | | 501 | 125 | 25.0 | 250* | | | | | | |
| | | Max | | 37500 | | | | 1500 | 375 | 75.1 | 751* | | | | | | |
| | Rev. | Avg | 325 | 4070 | | | | | 33.9 | | 54.2 | 40.7 | | | | | |
| | | Max | | 9490 | | | | | 102 | | 136 | 122 | | | | | |
| Red.-Cont.(2) | 1976 | Avg | 1200 | 12500 | | | | 501 | 125 | 25.0 | 250* | | | | | | |
| | | Max | | 37500 | | | | 1500 | 375 | 75.1 | 751* | | | | | | |
| | Rev. | Avg | 1820 | 22800 | | | | | 190 | | 304 | 228 | | | | | |
| | | Max | | 53200 | | | | | 759 | | 569 | 683 | | | | | |
| Sulf. Acid Pickl. | | | | | | | | | | | | | | | | | |
| Batch & Continuous Acid Recovery | 1976 | Avg | 0 | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Batch Neut. | 1976 | Avg | 360 | 7510 | 1500(3) | | | 150 | | | | | | | | | |
| | | Max | | 22500 | 4500(3) | | | 450 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Cont. Neut. wo/SPL | 1976 | Avg | 225 | 4690 | 939(3) | | | 93.9 | | | | | | | | | |
| | | Max | | 14100 | 2820(3) | | | 282 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Cont. Neut. w/SPL | 1976 | Avg | 250 | 5210 | 1040(3) | | | 104 | | | | | | | | | |
| | | Max | | 15600 | 3120(3) | | | 313 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Strip/Sheet/Plate | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 180 | 2250 | 751(3) | | | | | | | | 7.51 | 11.3 | | | |
| | | Max | | 5260 | 2250(3) | | | | | | | | 22.5 | 33.8 | | | |
| Rod/Wire/Coil | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 280 | 3500 | 1170(3) | | | | | | | | 11.7 | 17.5 | | | |
| | | Max | | 8180 | 3500(3) | | | | | | | | 35.0 | 52.6 | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
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| Subcategory | | | Discharge Flow (GPT) | BPT Effluent Limitations (kg/kkg x $10^{-5}$) | | | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | 55 | 85 |
| Bar/Billet/Bloom | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 90 | 1130 | 375(3) | | | | | | | | 3.75 | 5.63 | | | |
| | | Max | | 2630 | 1130(3) | | | | | | | | 11.3 | 16.9 | | | |
| Pipe/Tube/Other | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 500 | 6260 | 2090(3) | | | | | | | | 20.9 | 31.3 | | | |
| | | Max | | 14600 | 6260(3) | | | | | | | | 62.6 | 93.9 | | | |
| Fume Scrub.(5) | 1976 | Avg | No Separate Limitations Proposed | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 15 GPM | 245000 | 81900(3) | | | | | | | | 819 | 1230 | | | |
| | | Max | | 572000 | 245000(3) | | | | | | | | 2450 | 3680 | | | |
| HCl Acid Pickl. | | | | | | | | | | | | | | | | | |
| Cont. Neut. w/s | 1976 | Avg | 280 | 5840 | 1170(3) | | | 117 | | | | | | | | | |
| | | Max | | 17500 | 3510(3) | | | 351 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Cont. Neut. wo/s | 1976 | Avg | 230 | 4800 | 960(3) | | | 96.0 | | | | | | | | | |
| | | Max | | 14400 | 2880(3) | | | 288 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Cont. Regen. w/s | 1976 | Avg | 450 | 9380 | 1870(3) | | | 187 | | | | | | | | | |
| | | Max | | 28100 | 5610(3) | | | 561 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Cont. Regen. wo/s | 1976 | Avg | 400 | 8340 | 1660(3) | | | 166 | | | | | | | | | |
| | | Max | | 2500 | 4980(3) | | | 498 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Bat. Neut. w/s | 1976 | Avg | 280 | 5840 | 1170(3) | | | 117 | | | | | | | | | |
| | | Max | | 17500 | 3510(3) | | | 351 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Bat. Neut. wo/s | 1976 | Avg | 230 | 4800 | 960(3) | | | 96.0 | | | | | | | | | |
| | | Max | | 14400 | 2880(3) | | | 288 | | | | | | | | | |
| | Rev. | Avg | Subdivision Eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
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| | | | | BPT Effluent Limitations (kg/kkg x $10^{-5}$) | | | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory | | | Discharge Flow (GPT) | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | 55 | 85 |
| Strip/Sheet/Plate | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 280 | 3500 | 1170$^{(3)}$ | | | | | | | | 11.7 | 17.5 | | | |
| | | Max | | 8180 | 3500$^{(3)}$ | | | | | | | | 35.0 | 52.6 | | | |
| Rod/Wire/Coil | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 490 | 6130 | 2040$^{(3)}$ | | | | | | | | 20.4 | 30.7 | | | |
| | | Max | | 14300 | 6130$^{(3)}$ | | | | | | | | 61.3 | 92.0 | | | |
| Pipe, Tube & Other | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 1020 | 12800 | 4260$^{(3)}$ | | | | | | | | 42.6 | 63.8 | | | |
| | | Max | | 29800 | 12800$^{(3)}$ | | | | | | | | 128 | 191 | | | |
| Regeneration$^{(5)}$ | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 100 GPM | 1630000 | 545000$^{(3)}$ | | | | | | | | 5450 | 8190 | | | |
| | | Max | | 3810000 | 1630000$^{(3)}$ | | | | | | | | 16300 | 24500 | | | |
| Fume Scrub.$^{(5)}$ | 1976 | Avg | No Separate Limitations Proposed | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 15 GPM | 245000 | 81900$^{(3)}$ | | | | | | | | 819 | 1230 | | | |
| | | Max | | 572000 | 245000$^{(3)}$ | | | | | | | | 2450 | 3680 | | | |
| Comb. Acid Pickl. Cont. | 1976 | Avg | 1000 | 10400 | 4170$^{(3)}$ | | | 417 | | | 209* | 104* | | | 6260 | | |
| | | Max | | 31200 | 12500$^{(3)}$ | | | 1250 | | | 627* | 312* | | | 18800 | | |
| | Rev. | Avg | 1500 | 18800 | 6260$^{(3)}$ | | | | | | 250 | 188 | | | | | |
| | | Max | | 43800 | 18800$^{(3)}$ | | | | | | 626 | 563 | | | | | |
| Bat., P & T | 1976 | Avg | 700 | 7300 | 2920$^{(3)}$ | | | 292 | | | 146* | 73.0* | | | 4380 | | |
| | | Max | | 21900 | 8760$^{(3)}$ | | | 876 | | | 438* | 219* | | | 13100 | | |
| | Rev. | Avg | 770 | 9640 | 3210$^{(3)}$ | | | | | | 128 | 96.4 | | | | | |
| | | Max | | 22500 | 9640$^{(3)}$ | | | | | | 321 | 289 | | | | | |
| Bat. Other | 1976 | Avg | 200 | 2090 | 834$^{(3)}$ | | | 83.4 | | | 41.7* | 20.9* | | | 1250 | | |
| | | Max | | 6270 | 2500$^{(3)}$ | | | 250 | | | 125* | 62.7* | | | 3750 | | |
| | Rev. | Avg | Subdivision eliminated | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| Bat. Strip/Sheet/ Plate | 1976 | Avg | New Subdivision | | | | | | | | | | | | | | |
| | | Max | | | | | | | | | | | | | | | |
| | Rev. | Avg | 460 | 5760 | 1920$^{(3)}$ | | | | | | 76.8 | 57.6 | | | | | |
| | | Max | | 13400 | 5760$^{(3)}$ | | | | | | 192 | 173 | | | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
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| | | | BPT Effluent Limitations (kg/kkg x 10$^{-5}$) | | | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory | | Discharge Flow (GPT) | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | Cr$^{+6}$ | Cr | Ni | Zn | Pb | F | 55 | 85 |
| Rod/Wire/Coil | 1976 Avg | | New Subdivision | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | 510 | 6380 | 2130(3) | | | | | | 85.1 | 63.8 | | | | | |
| | Max | | 14900 | 6380(3) | | | | | | 213 | 191 | | | | | |
| Bar/Billet/Bloom | 1976 Avg | | New Subdivision | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | 230 | 2880 | 960(3) | | | | | | 38.4 | 28.8 | | | | | |
| | Max | | 6720 | 2880(3) | | | | | | 96.0 | 86.4 | | | | | |
| Fume Scrubber(5) | 1976 Avg | | No separate limitations proposed | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | 15 GPM | 245000 | 81900(3) | | | | | | 3270 | 2450 | | | | | |
| | Max | | 572000 | 245000(3) | | | | | | 8190 | 7350 | | | | | |
| Cold Forming | 1976 Avg | 25 | 261 | 104 | | | 10.4(4) | | | | | | | | | |
| CR-Single Recir. | Max | | 783 | 312 | | | 31.2(4) | | | | | | | | | |
| | Rev. Avg | 5 | 62.6 | 20.9 | | | | | | 0.83(7) | 0.63(7) | 0.21 | 0.31 | | - | - |
| | Max | | 125 | 52.2 | | | | | | 2.09(7) | 1.88(7) | 0.63 | 0.94 | | 0.21 | 0.31 |
| CR-Multi Recirc. | 1976 Avg | 25 | 261 | 104 | | | 10.4(4) | | | | | | | | | |
| | Max | | 783 | 312 | | | 31.2(4) | | | | | | | | | |
| | Rev. Avg | 25 | 313 | 104 | | | | | | 4.17(7) | 3.13(7) | 1.04 | 1.56 | | - | - |
| | Max | | 626 | 261 | | | | | | 10.4(7) | 9.39(7) | 3.13 | 4.69 | | 1.04 | 1.56 |
| CR-Comb. | 1976 Avg | 400 | 4170 | 1670 | | | 167(4) | | | | | | | | | |
| | Max | | 12500 | 5010 | | | 501(4) | | | | | | | | | |
| | Rev. Avg | 300 | 3750 | 1250 | | | | | | 50.1(7) | 37.5(7) | 12.5 | 18.8 | | - | - |
| | Max | | 7510 | 3130 | | | | | | 125(7) | 113(7) | 37.5 | 56.3 | | 12.5 | 18.8 |
| CR-Single DA | 1976 Avg | 1000 | 10400 | 4170 | | | 417(4) | | | | | | | | | |
| | Max | | 31200 | 12500 | | | 1250(4) | | | | | | | | | |
| | Rev. Avg | 90 | 1130 | 375 | | | | | | 15.0(7) | 11.3(7) | 3.75 | 5.63 | | - | - |
| | Max | | 2250 | 939 | | | | | | 37.5(7) | 33.8(7) | 11.3 | 16.9 | | 3.75 | 5.63 |
| CR-Multi DA | 1976 Avg | 1000 | 10400 | 4170 | | | 417 | | | | | | | | | |
| | Max | | 31200 | 12500 | | | 1250 | | | | | | | | | |
| | Rev. Avg | 400 | 5010 | 1670 | | | | | | 66.8(7) | 50.1(7) | | 16.7 | 25.0 | - | - |
| | Max | | 10000 | 4170 | | | | | | 167(7) | 150(7) | | 50.1 | 75.1 | 16.7 | 25.0 |
| P&T | 1976 Avg | 1002 | 14200 | 4180 | | | | | | | | | | | | |
| | Max | | 42600 | 12500 | | | | | | | | | | | | |
| | Rev. Avg | 0 | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
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| Subcategory | | Discharge Flow (GPT) | BPT Effluent Limitations (kg/kkg x $10^{-5}$) | | | | | | | | | | | | Toxic Organics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | F | 55 | 85 |
| Alkaline Cleaning Batch | 1976 Avg | 50 | 522 | | | | 20.9 | | | 10.4* | 5.22* | | | | | |
| | Max | | 1570 | | | | 62.6 | | | 31.3* | 15.6* | | | | | |
| | Rev. Avg | 250 | 3130 | 1040 | | | | | | | | | | | | |
| | Max | | 7300 | 3130 | | | | | | | | | | | | |
| Continuous | 1976 Avg | 50 | 522 | | | | 20.9 | | | 10.4* | 5.22* | | | | | |
| | Max | | 1570 | | | | 62.6 | | | 31.3* | 15.6* | | | | | |
| | Rev. Avg | 350 | 4380 | 1460 | | | | | | | | | | | | |
| | Max | | 10200 | 4380 | | | | | | | | | | | | |
| Hot Coating Galv-Strip/Sheet/ Misc w/s | 1976 Avg | 1200 | 25000 | 7500 | | | | | 10.0(7) | 1500 | | 2500 | | | | |
| | Max | | 75000 | 2250 | | | | | 30.0(7) | 4500 | | 7500 | | | | |
| | Rev. Avg | | Separate Allowance Given for Fume Scrubber | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Galv-Strip/Sheet/ Misc wo/s | 1976 Avg | 600 | 12500 | 3750 | | | | | 5.00(7) | 750 | | 1250 | | | | |
| | Max | | 37500 | 11300 | | | | | 15.0(7) | 2250 | | 3750 | | | | |
| | Rev. Avg | 600 | 7510 | 2500 | | | | | 5.01(7) | | | 25.0 | 37.5 | | | |
| | Max | | 17500 | 7510 | | | | | 15.0(7) | | | 75.1 | 113 | | | |
| Galv-Wire/Fast. w/s | 1976 Avg | | No Separate Limitations Proposed for this Segment | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | | Separate Allowance Given For Fume Scrubber | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Galv-Wire/Fast. wo/s | 1976 Avg | | No Separate Limitations Proposed for this Segment | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | 2400 | 30000 | 10000 | | | | | 20.0(7) | | | 100 | 150 | | | |
| | Max | | 70100 | 30000 | | | | | 60.1(7) | | | 300 | 451 | | | |
| Terne-w/s | 1976 Avg | 1200 | 25000 | 7500 | | | | | | | | | 250 | | | |
| | Max | | 75000 | 22500 | | | | | | | | | 750 | | | |
| | Rev. Avg | | Separate Allowance Given for Fume Scrubber | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Terne-wo/s | 1976 Avg | 600 | 12500 | 3750 | | | | | | | | | 250 | | | |
| | Max | | 37500 | 11300 | | | | | | | | | 750 | | | |
| | Rev. Avg | 600 | 7510 | 2500 | | | | | 5.01(7) | | | 25.0 | 37.5 | | | |
| | Max | | 17500 | 7510 | | | | | 15.0(7) | | | 75.1 | 113 | | | |
| Other Strip/Sheet Misc w/s | 1976 Avg | | No Separate Limitations Proposed for this Segment | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | | Separate Allowance Given For Fume Scrubber | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Other-Wire/Fast. Misc wo/s | 1976 Avg | | No Separate Limitations Proposed for this Segment | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| | Rev. Avg | 600 | 7510 | 2500 | | | | | 5.01(7) | | | 25.0 | 37.5 | | | |
| | Max | | 17500 | 7510 | | | | | 15.0(7) | | | 75.1 | 113 | | | |

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
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|  |  |  |  | BPT Effluent Limitations (kg/kkg x $10^{-5}$) |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory |  |  | Discharge Flow (GPT) | TSS | O&G | Ammonia | Phenol (4AAP) | Fe-D | CN-T | Cr$^{+6}$ | Cr | Ni | Zn | Pb | F | Toxic Organics 55 | Toxic Organics 85 |
| Other-Wire/Fast w/s | 1976 | Avg |  | No Separate Limitation Proposed for this Segment |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Rev. | Avg |  | Separate Allowance Given For Fume Scrubber |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Other-Wire Fast wo/s | 1976 | Avg |  | No Separate Limitations Porposed for this Segment |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Rev. | Avg | 2400 | 30000 | 10000 |  |  |  |  | 20.0(7) |  |  | 100 | 150 |  |  |  |
|  |  | Max |  | 70100 | 30000 |  |  |  |  | 60.1(7) |  |  | 300 | 451 |  |  |  |
| Fume Scrub.(5) | 1976 | Avg | No Separate Limitations Proposed for this Segment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Rev. | Avg | 100 GPM | 1630000 | 545000 |  |  |  |  | 1090(7) |  |  | 5450 | 8190 |  |  |  |
|  |  | Max |  | 3810000 | 1630000 |  |  |  |  | 3270(7) |  |  | 16300 | 24500 |  |  |  |

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(1) Original limits were for the kolene scale removal subcategory.
(2) Original limits were for the hydride scale removal subcategory.
(3) This load is allowed only when these wastes are treated in combination with cold rolling mill wastes.
(4) This load is allowed only when these wastes are treated in combination with pickling wastes.
(5) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. The loads are expressed in kg/day x $10^{-3}$.
(6) This load shall be applied in lieu of those for lead and zinc when cold rolling wastewaters are treted with descaling or combination acid pickling wastewaters.
(7) This load shall apply only to those galvanizing operations which discharge wastewater from a chromate rinse.
* : Dissolved Metal

NOTE: pH is also regulated in all subcategories and is limited to 6.0 - 9.0 standard units.

# TABLE I-3

## BAT CONCENTRATION AND FLOW SUMMARY
## IRON & STEEL INDUSTRY

| Subcategory | | Selected Option | Dis. Flow (GPT) | BAT Effluent Concentrations (mg/l) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Toxic Organics | | | | | | | | | |
| | | | | Ammonia | Chlor. | Phenol (4AAP) | (4) | (55) | (73) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| Cokemaking | | | | | | | | | | | | | | | | |
| I&S-Bio. | Avg | 1 | 153 | 25 | | 0.05 | - | - | - | | | 5.5 | | | | |
| | Max | | | 85 | | 0.1 | 0.05 | 0.05 | 0.05 | | | 10 | | | | |
| I&S-Phy. Chem. | Avg | 1 | 103 | 75 | | 0.1 | - | - | - | | | | | | | |
| | Max | | | 150 | | 0.2 | 0.05 | 0.05 | 0.05 | | | | | | | |
| Merch.-Bio. | Avg | 1 | 170 | 25 | | 0.05 | - | - | - | | | 5.5 | | | | |
| | Max | | | 85 | | 0.1 | 0.05 | 0.05 | 0.05 | | | 10 | | | | |
| Merch.-Phy. Chem. | Avg | 1 | 120 | 75 | | 0.1 | - | - | - | | | - | | | | |
| | Max | | | 150 | | 0.2 | 0.05 | 0.05 | 0.05 | | | - | | | | |
| Beehive | Avg | BPT | 0 | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Sintering | Avg | 1 | 120 | 10 | - | 0.1 | | | | | | 1 | 0.25 | | 0.3 | |
| | Max | | | 30 | 0.5 | 0.2 | | | | | | 2 | 0.75 | | 0.9 | |
| Ironmaking | | | | | | | | | | | | | | | | |
| Iron | Avg | 4 | 70 | 10 | - | 0.1 | | | | | | 1 | 0.25 | | 0.3 | |
| | Max | | | 30 | 0.5 | 0.2 | | | | | | 2 | 0.75 | | 0.9 | |
| Ferromanganese | Avg | Reserved | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Steelmaking | | | | | | | | | | | | | | | | |
| BOF: Semi-wet | Avg | BPT | 0 | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| BOF: Wet-Open | Avg | 2 | 110 | | | | | | | | | | 0.3 | | 0.45 | |
| | Max | | | | | | | | | | | | 0.9 | | 1.35 | |
| BOF: Wet-Supp. | Avg | 2 | 50 | | | | | | | | | | 0.3 | | 0.45 | |
| | Max | | | | | | | | | | | | 0.9 | | 1.35 | |
| Open Hearth | Avg | 2 | 110 | | | | | | | | | | 0.3 | | 0.45 | |
| | Max | | | | | | | | | | | | 0.9 | | 1.35 | |
| EAF: Semi-wet | Avg | BPT | 0 | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| EAF: Wet | Avg | 2 | 110 | | | | | | | | | | 0.3 | | 0.45 | |
| | Max | | | | | | | | | | | | 0.9 | | 1.35 | |
| Vacuum Degassing | Avg | 2 | 25 | | | | | | | | | | 0.3 | | 0.45 | |
| | Max | | | | | | | | | | | | 0.9 | | 1.35 | |
| Continuous Casting | Avg | 2 | 25 | | | | | | | | | | 0.3 | | 0.45 | |
| | Max | | | | | | | | | | | | 0.9 | | 1.35 | |
| Hot Forming | | | | | | | | | | | | | | | | |
| Prim.: C&S w/os | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Prim.: C&S w/s | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Sect.: Carb. | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Sect.: Spec. | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |

TABLE I-3
BAT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

| | | | | BAT Effluent Concentrations (mg/l) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory | | Selected Option | Dis. Flow (GPT) | Ammonia | Chlor. | Phenol (4AAP) | Toxic Organics (4) | Toxic Organics (55) | Toxic Organics (73) | Toxic Organics (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| Flat: HS&S (C&S) | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Flat: Plate-Carb. | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Flat: Plate-Spec. | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| P&T | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Salt Bath-Descaling | | | | | | | | | | | | | | | | |
| Ox.-Bat. S&P | Avg | BPT | 700 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Ox.-Bat. R&W | Avg | BPT | 420 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Ox.-Bat. P&T | Avg | BPT | 1700 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Ox.-Cont. | Avg | BPT | 330 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Red.-Bat. | Avg | BPT | 325 | | | | | | | | 0.4 | 0.25 | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | 0.75 | | 0.9 | | |
| Red.-Cont. | Avg | BPT | 1820 | | | | | | | | 0.4 | 0.25 | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | 0.75 | | 0.9 | | |
| Sulf. Acid Pickling | | | | | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | BPT | 280 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Bar, Billet, Bloom | Avg | BPT | 90 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Strip, Sheet, Plate | Avg | BPT | 180 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Pipe, Tube & Other | Avg | BPT | 500 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Fume Scrub.(1) | Avg | BPT | 15 GPM | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| HCl Acid Pickling | | | | | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | BPT | 490 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Strip, Sheet, Plate | Avg | BPT | 280 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Pipe, Tube & Other | Avg | BPT | 1020 | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Fume Scrub.(1) | Avg | BPT | 15 GPM | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |
| Acid Regeneration | Avg | BPT | 100 GPM | | | | | | | | | | 0.15 | | 0.1 | |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | |

TABLE I-3
BAT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| Subcategory | | Selected Option | Dis. Flow (GPT) | BAT Effluent Concentrations (mg/l) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Toxic Organics | | | | | | | | | |
| | | | | Ammonia | Chlor. | Phenol (4AAP) | (4) | (55) | (73) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | Cr+6 |
| Comb-Acid Pickling | | | | | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | BPT | 510 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Bar, Billet, Bloom | Avg | BPT | 230 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Cont-S, S&P | Avg | BPT | 1500 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Bat.-S, S&P | Avg | BPT | 460 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| P&T & Oth. | Avg | BPT | 770 | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Fume Scrub.(1) | Avg | BPT | 15 GPM | | | | | | | | 0.4 | | | 0.3 | | |
| | Max | | | | | | | | | | 1.0 | | | 0.9 | | |
| Cold Forming | | | | | | | | | | | | | | | | |
| CR: Recir-Single | Avg | BPT | 5 | | | | | - | | - | 0.4(2) | | 0.15 | 0.3(2) | 0.1 | |
| | Max | | | | | | | 0.1 | | 0.15 | 1.0(2) | | 0.45 | 0.9(2) | 0.3 | |
| CR: Recir-Multi. | Avg | BPT | 25 | | | | | - | | - | 0.4(2) | | 0.15 | 0.3(2) | 0.1 | |
| | Max | | | | | | | 0.1 | | 0.15 | 1.0(2) | | 0.45 | 0.9(2) | 0.3 | |
| CR: Comb. | Avg | BPT | 300 | | | | | - | | - | 0.4(2) | | 0.15 | 0.3(2) | 0.1 | |
| | Max | | | | | | | 0.1 | | 0.15 | 1.0(2) | | 0.45 | 0.9(2) | 0.3 | |
| CR: DA-Single | Avg | BPT | 90 | | | | | - | | - | 0.4(2) | | 0.15 | 0.3(2) | 0.1 | |
| | Max | | | | | | | 0.1 | | 0.15 | 1.0(2) | | 0.45 | 0.9(2) | 0.3 | |
| CR: DA-Multi. | Avg | BPT | 400 | | | | | - | | - | 0.4(2) | | 0.15 | 0.3(2) | 0.1 | |
| | Max | | | | | | | 0.1 | | 0.15 | 1.0(2) | | 0.45 | 0.9(2) | 0.3 | |
| P&T | Avg | BPT | 0 | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Alkaline Cleaning | | | | | | | | | | | | | | | | |
| Batch | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Continuous | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Hot Coating (all operations) | | | | | | | | | | | | | | | | |
| S, S&Misc. wo/scrub | Avg | BPT | 600 | | | | | | | | | | 0.15 | | 0.1 | 0.02(3) |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | 0.06(3) |
| W/Fast wo/scrub | Avg | BPT | 2400 | | | | | | | | | | 0.15 | | 0.1 | 0.02(3) |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | 0.06(3) |
| Fume Scrub.(1) | Avg | 1 | 15 GPM | | | | | | | | | | 0.15 | | 0.1 | 0.02(3) |
| | Max | | | | | | | | | | | | 0.45 | | 0.3 | 0.06(3) |

TABLE I-3
BAT CONCENTRATION AND FLOW SUMMARY
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(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
(2) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(3) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-4

BAT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY

| Subcategory | | Selected Option | Discharge Flow (GPT) | BAT Effluent Limitations (kg/kkg x $10^{-5}$) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Toxic Organics | | | | | | | | | |
| | | | | Ammonia | Chlorine | Phenol (4AAP) | (4) | (55) | (73) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| **Cokemaking** | | | | | | | | | | | | | | | | |
| **I&S-Bio.** | **Avg** | 1 | 153 | 1600 | | 3.19 | - | - | - | | | 351 | | | | |
| | **Max** | | | 5430 | | 6.38 | 3.19 | 3.19 | 3.19 | | | 638 | | | | |
| **I&S-Phy. Chem.** | **Avg** | 1 | 103 | 3220 | | 4.30 | - | - | - | | | | | | | |
| | **Max** | | | 6450 | | 8.59 | 2.15 | 2.15 | 2.15 | | | | | | | |
| **Merch.-Bio.** | **Avg** | 1 | 170 | 1770 | | 3.55 | - | - | - | | | 390 | | | | |
| | **Max** | | | 6030 | | 7.09 | 3.55 | 3.55 | 3.55 | | | 709 | | | | |
| **Merch.-Phy. Chem.** | **Avg** | 1 | 120 | 3750 | | 5.01 | - | - | - | | | | | | | |
| | **Max** | | | 7510 | | 10.0 | 2.50 | 2.50 | 2.50 | | | | | | | |
| **Beehive** | **Avg** | BPT | 0 | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **Sintering** | **Avg** | 1 | 120 | 501 | - | 5.01 | | | | | | 50.1 | 12.5 | | 15.0 | |
| | **Max** | | | 1500 | 25.0 | 10.0 | | | | | | 100 | 37.5 | | 45.1 | |
| **Ironmaking** | | | | | | | | | | | | | | | | |
| **Iron** | **Avg** | 4 | 70 | 292 | - | 2.92 | | | | | | 29.2 | 7.30 | | 8.76 | |
| | **Max** | | | 876 | 14.6 | 5.84 | | | | | | 58.4 | 21.9 | | 26.3 | |
| **Ferromanganese** | **Avg** | Reserved | | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **Steelmaking** | | | | | | | | | | | | | | | | |
| **BOF: Semi-Wet** | **Avg** | BPT | 0 | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **BOF: Wet-Open** | **Avg** | 2 | 110 | | | | | | | | | | 13.8 | | 20.7 | |
| | **Max** | | | | | | | | | | | | 41.3 | | 62.0 | |
| **BOF: Wet-Sup.** | **Avg** | 2 | 50 | | | | | | | | | | 6.26 | | 9.39 | |
| | **Max** | | | | | | | | | | | | 18.8 | | 28.2 | |
| **Open Hearth** | **Avg** | 2 | 110 | | | | | | | | | | 13.8 | | 20.7 | |
| | **Max** | | | | | | | | | | | | 41.3 | | 62.0 | |
| **EAF: Semi-Wet** | **Avg** | BPT | 0 | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **EAF: Wet** | **Avg** | 2 | 110 | | | | | | | | | | 13.8 | | 20.7 | |
| | **Max** | | | | | | | | | | | | 41.3 | | 62.0 | |
| **Vaccum Degassing** | **Avg** | 2 | 25 | | | | | | | | | | 3.13 | | 4.69 | |
| | **Max** | | | | | | | | | | | | 9.39 | | 14.1 | |
| **Continuous Casting** | **Avg** | 2 | 25 | | | | | | | | | | 3.13 | | 4.69 | |
| | **Max** | | | | | | | | | | | | 9.39 | | 14.1 | |
| **Hot Forming** | | | | | | | | | | | | | | | | |
| **Prim.: C&S/wos** | **Avg** | No BAT Selected | | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **Prim.: C&S/ws** | **Avg** | No BAT Selected | | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **Sect.: Carb.** | **Avg** | No BAT Selected | | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |
| **Sect.: Spec.** | **Avg** | No BAT Selected | | | | | | | | | | | | | | |
| | **Max** | | | | | | | | | | | | | | | |

TABLE I-4
BAT EFFLUENT LIMITAITONS SUMMARY
IRON & STEEL INDUSTRY
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|  |  |  |  | BAT Effluent Limitations (kg/kkg x $10^{-5}$) |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  | Toxic Organics |  |  |  |  |  |  |  |  |  |
| Subcategory |  | Selected Option | Discharge Flow (GPT) | Ammonia | Chlorine | Phenol (4AAP) | (4) | (55) | (73) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| Flat: HS&S (C&S) | Avg | No BAT Selected |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Flat: Plate-Carb. | Avg | No BAT Selected |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Flat: Plate-Spec. | Avg | No BAT Selected |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| P&T | Avg | No BAT Selected |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Salt Bath-Descal. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ox.: Bat. S&P | Avg | BPT | 700 |  |  |  |  |  |  |  | 117 |  |  | 87.6 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 292 |  |  | 263 |  |  |
| Ox.: Bat. R&W | Avg | BPT | 420 |  |  |  |  |  |  |  | 70.1 |  |  | 52.6 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 175 |  |  | 158 |  |  |
| Ox.: Bat. P&T | Avg | BPT | 1700 |  |  |  |  |  |  |  | 284 |  |  | 213 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 709 |  |  | 638 |  |  |
| Ox.: Cont. | Avg | BPT | 330 |  |  |  |  |  |  |  | 55.1 |  |  | 41.3 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 138 |  |  | 124 |  |  |
| Red.: Bat. | Avg | BPT | 325 |  |  |  |  |  |  |  | 54.2 | 33.9 |  | 40.7 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 136 | 102 |  | 122 |  |  |
| Red.: Cont. | Avg | BPT | 1820 |  |  |  |  |  |  |  | 304 | 190 |  | 228 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 759 | 569 |  | 683 |  |  |
| Sulf. Acid Pickl. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rod, Wire, Coil | Avg | BPT | 280 |  |  |  |  |  |  |  |  |  | 17.5 |  | 11.7 |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  | 52.6 |  | 35.0 |  |
| Bar, Billet, Bloom | Avg | BPT | 90 |  |  |  |  |  |  |  |  |  | 5.63 |  | 3.75 |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  | 16.9 |  | 11.3 |  |
| Strip, Sheet, Plate | Avg | BPT | 180 |  |  |  |  |  |  |  |  |  | 11.3 |  | 7.51 |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  | 33.8 |  | 22.5 |  |
| Pipe, Tube & Other | Avg | BPT | 500 |  |  |  |  |  |  |  |  |  | 31.3 |  | 20.9 |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  | 93.9 |  | 62.6 |  |
| Fume Scrub.(1) | Avg | BPT | 15 gpm |  |  |  |  |  |  |  |  |  | 1230 |  | 819 |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  | 3680 |  | 2450 |  |
| Comb. Acid Pickling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rod, Wire & Coil | Avg | BPT | 510 |  |  |  |  |  |  |  | 85.1 |  |  | 63.8 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 231 |  |  | 191 |  |  |
| Bar, Billet & Bloom | Avg | BPT | 230 |  |  |  |  |  |  |  | 38.4 |  |  | 28.8 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 96.0 |  |  | 86.4 |  |  |
| Cont. S, S&P | Avg | BPT | 1500 |  |  |  |  |  |  |  | 250 |  |  | 188 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 626 |  |  | 563 |  |  |
| Bat. S, S&P | Avg | BPT | 460 |  |  |  |  |  |  |  | 76.8 |  |  | 57.6 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 192 |  |  | 173 |  |  |
| Pipe, Tube & Other | Avg | BPT | 770 |  |  |  |  |  |  |  | 128 |  |  | 96.4 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 321 |  |  | 289 |  |  |
| Fume Scrub.(1) | Avg | BPT | 15 gpm |  |  |  |  |  |  |  | 3270 |  |  | 2450 |  |  |
|  | Max |  |  |  |  |  |  |  |  |  | 8190 |  |  | 7350 |  |  |

TABLE I-4
BAT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| Subcategory | | Selected Option | Discharge Flow (GPT) | BAT Effluent Limitation (kg/kkg x $10^{-5}$)<br>Ammonia | Chlorine | Phenol (4AAP) | Toxic Organics<br>(4) | (55) | (73) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCl Acid Pickling | | | | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | BPT | 490 | | | | | | | | | | 30.7 | | 20.4 | |
| | Max | | | | | | | | | | | | 92.0 | | 61.3 | |
| Strip, Sheet & Plate | Avg | BPT | 280 | | | | | | | | | | 17.5 | | 11.7 | |
| | Max | | | | | | | | | | | | 52.6 | | 35.0 | |
| Pipe, Tube & Other | Avg | BPT | 1020 | | | | | | | | | | 63.9 | | 42.6 | |
| | Max | | | | | | | | | | | | 191 | | 128 | |
| Fume Scrubber(1) | Avg | BPT | 15 GPM | | | | | | | | | | 1230 | | 819 | |
| | Max | | | | | | | | | | | | 3680 | | 2450 | |
| Acid Regeneration(1) | Avg | BPT | 100 GPM | | | | | | | | | | 8190 | | 5450 | |
| | Max | | | | | | | | | | | | 24500 | | 16300 | |
| Cold Forming | | | | | | | | | | | | | | | | |
| CR: Recir-Sing | Avg | BPT | 5 | | | | | - | | - | 0.83(2) | | 0.31 | 0.63(2) | 0.21 | |
| | Max | | | | | | | 0.21 | | 0.31 | 2.09(2) | | 0.94 | 1.88(2) | 0.63 | |
| CR: Recir-Multi | Avg | BPT | 25 | | | | | - | | - | 4.17(2) | | 1.56 | 3.13(2) | 1.04 | |
| | Max | | | | | | | 1.04 | | 1.56 | 10.4(2) | | 4.69 | 9.39(2) | 3.13 | |
| CR: Comb. | Avg | BPT | 300 | | | | | - | | - | 50.1(2) | | 18.8 | 37.5(2) | 12.5 | |
| | Max | | | | | | | 12.5 | | 18.8 | 125(2) | | 56.3 | 113(2) | 37.8 | |
| CR: DA-Sing | Avg | BPT | 90 | | | | | - | | - | 15.0(2) | | 5.63 | 11.3(2) | 3.75 | |
| | Max | | | | | | | 3.75 | | 5.63 | 37.5(2) | | 16.9 | 33.8(2) | 11.3 | |
| CR: DA-Multi | Avg | BPT | 400 | | | | | - | | - | 66.8(2) | | 25.0 | 50.1(2) | 16.7 | |
| | Max | | | | | | | 16.7 | | 25.0 | 167(2) | | 75.1 | 150(2) | 50.1 | |
| P&T | Avg | BPT | 0 | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Alkaline Cleaning | | | | | | | | | | | | | | | | |
| Batch | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Continuous | Avg | No BAT Selected | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | |
| Hot Coat-inc. all coat | | | | | | | | | | | | | | | | |
| S, S&Misc. wo/scrub | Avg | BPT | 600 | | | | | | | | | | 37.5 | | 25.0 | 5.01(3) |
| | Max | | | | | | | | | | | | 113 | | 75.1 | 15.0(3) |
| W/Fast wo/scrub | Avg | BPT | 2400 | | | | | | | | | | 150 | | 100 | 20.0(3) |
| | Max | | | | | | | | | | | | 451 | | 300 | 60.1(3) |
| Fume Scrub.(1) | Avg | 1 | 15 GPM | | | | | | | | | | 1230 | | 819 | 164 |
| | Max | | | | | | | | | | | | 3680 | | 2450 | 490 |

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(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. The load is expressed in kg/day x $10^{-5}$.

(2) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.

(3) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

(4) The absorber vent scrubber load is expressed in kg/day x $10^{-5}$.

## TABLE I-5

## PSNS/NSPS CONCENTRATION AND FLOW SUMMARY IRON & STEEL INDUSTRY

| Subcategory | | Selected Option | Discharge Flow (GPT) | PSNS/NSPS Effluent Concentrations (mg/1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TSS$^{(1)}$ | O & G$^{(1)}$ | Ammonia | Chlorine$^{(1)}$ | Phenol (4AAP) | Toxic Organics (4) | (55) | (73) | (85) |
| Cokemaking | | | | | | | | | | | | |
| Iron & Steel 1$^{(2)}$ | Avg | NSPS-1 | 153 | 140 | - | 25 | | 0.05 | - | - | - | |
| | Max | | | 270 | 10 | 85 | | 0.1 | 0.05 | 0.05 | 0.05 | |
| Iron & Steel $^{(3)}$ | Avg | PSNS-1 | 103 | | | 75 | | 50 | | | | |
| | Max | | | | | 150 | | 100 | | | | |
| Merchant$^{(2)}$ | Avg | NSPS-1 | 170 | 140 | - | 25 | | 0.05 | - | - | - | |
| | Max | | | 270 | 10 | 85 | | 0.1 | 0.05 | 0.05 | 0.05 | |
| Merchant$^{(3)}$ | Avg | PSNS-1 | 120 | | | 75 | | 50 | | | | |
| | Max | | | | | 150 | | 100 | | | | |
| Beehive | Avg | BPT | 0 | | | | | | | | | |
| | Max | | | | | | | | | | | |
| Sintering | Avg | NSPS-1 | 120 | 15 | - | 10 | - | 0.1 | | | | |
| | Max | PSNS-2 | | 40 | 10 | 30 | 0.5 | 0.2 | | | | |
| Ironmaking | | | | | | | | | | | | |
| Iron | Avg | NSPS-5 | 70 | 15 | | 10 | - | 0.1 | | | | |
| | Max | PSNS-5 | | 40 | 10 | 30 | 0.5 | 0.2 | | | | |
| Ferromanganese | Avg | Reserved | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| Steelmaking | | | | | | | | | | | | |
| BOF: Semi-wet | Avg | Reserved | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| BOF: Wet-Open | Avg | NSPS-2 | 110 | 25 | | | | | | | | |
| | Max | PSNS-3 | | 70 | | | | | | | | |
| BOF: Wet-Supp. | Avg | NSPS-2 | 50 | 25 | | | | | | | | |
| | Max | PSNS-3 | | 70 | | | | | | | | |
| Open Hearth - Wet | Avg | NSPS-2 | 110 | 25 | | | | | | | | |
| | Max | PSNS-3 | | 70 | | | | | | | | |
| EAF: Semi-wet | Avg | Reserved | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| EAF: Wet | Avg | NSPS-2 | 110 | 25 | | | | | | | | |
| | Max | PSNS-3 | | 70 | | | | | | | | |
| Vacuum Degassing | Avg | NSPS-3 | 25 | 25 | | | | | | | | |
| | Max | PSNS-3 | | 70 | | | | | | | | |
| Continuous Casting | Avg | NSPS-3 | 25 | 25 | 10 | | | | | | | |
| | Max | PSNS-3 | | 70 | 30 | | | | | | | |
| Hot Forming | | | | | | | | | | | | |
| Prim.: C&S w/os$^{(2)}$ | Avg | NSPS-1 | 90 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| Prim.: C&S w/s$^{(2)}$ | Avg | NSPS-1 | 140 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| Sect.: Carb.$^{(2)}$ | Avg | NSPS-1 | 200 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| Sect.: Spec.$^{(2)}$ | Avg | NSPS-1 | 130 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| Flat: HS&S (C&S)$^{(2)}$ | Avg | NSPS-1 | 260 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| Flat: Plate-Carb.$^{(2)}$ | Avg | NSPS-1 | 140 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| Flat: Plate-Spec.$^{(2)}$ | Avg | NSPS-1 | 60 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |
| P&T$^{(2)}$ | Avg | NSPS-1 | 220 | 15 | - | | | | | | | |
| | Max | | | 40 | 10 | | | | | | | |

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 1 CONT.

| Subcategory | | PSNS/NSPS Effluent Concentrations (mg/l) Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
|---|---|---|---|---|---|---|---|
| Cokemaking | | | | | | | |
| Iron & Steel I(2) | Avg | | 5.5 | | | | |
| | Max | | 10 | | | | |
| Iron & Steel (3) | Avg | | 20 | | | | |
| | Max | | 40 | | | | |
| Merchant(2) | Avg | | 5.5 | | | | |
| | Max | | 10 | | | | |
| Merchant(3) | Avg | | 20 | | | | |
| | Max | | 40 | | | | |
| Beehive | Avg | | | | | | |
| | Max | | | | | | |
| Sintering | Avg | | 1 | 0.25 | | 0.3 | |
| | Max | | 2 | 0.75 | | 0.9 | |
| Ironmaking | | | | | | | |
| Iron | Avg | | 1 | 0.25 | | 0.3 | |
| | Max | | 2 | 0.75 | | 0.9 | |
| Ferromanganese | Avg | | | | | | |
| | Max | | | | | | |
| Steelmaking | | | | | | | |
| BOF: Semi-wet | Avg | | | | | | |
| | Max | | | | | | |
| BOF: Wet-Open | Avg | | | 0.3 | | 0.45 | |
| | Max | | | 0.9 | | 1.35 | |
| BOF: Wet-Supp. | Avg | | | 0.3 | | 0.45 | |
| | Max | | | 0.9 | | 1.35 | |
| Open Hearth - Wet | Avg | | | 0.3 | | 0.45 | |
| | Max | | | 0.9 | | 1.35 | |
| EAF: Semi-wet | Avg | | | | | | |
| | Max | | | | | | |
| EAF: Wet | Avg | | | 0.3 | | 0.45 | |
| | Max | | | 0.9 | | 1.35 | |
| Vacuum Degassing | Avg | | | 0.3 | | 0.45 | |
| | Max | | | 0.9 | | 1.35 | |
| Continuous Casting | Avg | | | 0.3 | | 0.45 | |
| | Max | | | 0.9 | | 1.35 | |
| Hot Forming | | | | | | | |
| Prim.: C&S w/os(2) | Avg | | | | | | |
| | Max | | | | | | |
| Prim.: C&S w/s(2) | Avg | | | | | | |
| | Max | | | | | | |
| Sect.: Carb.(2) | Avg | | | | | | |
| | Max | | | | | | |
| Sect.: Spec.(2) | Avg | | | | | | |
| | Max | | | | | | |
| Flat: HS&S (C&S)(2) | Avg | | | | | | |
| | Max | | | | | | |
| Flat: Plate-Carb.(2) | Avg | | | | | | |
| | Max | | | | | | |
| Flat: Plate-Spec.(2) | Avg | | | | | | |
| | Max | | | | | | |
| P&T(2) | Avg | | | | | | |
| | Max | | | | | | |

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

| | | | | PSNS/NSPS Effluent Concentrations (mg/l) | | | | | Toxic Organics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory | | Selected Option | Discharge Flow (GPT) | TSS$^{(1)}$ | O & G$^{(1)}$ | Ammonia | Chlorine$^{(1)}$ | Phenol (4AAP) | (4) | (55) | (73) | (85) |
| Salt Bath-Descal. | | | | | | | | | | | | |
| Ox.-Bat. S&P | Avg | NSPS-1 | 280 | 30 | | | | | | | | |
| | Max | PSNS-1 | | 70 | | | | | | | | |
| Ox.-Bat. R&W | Avg | NSPS-1 | 170 | 30 | | | | | | | | |
| | Max | PSNS-1 | | 70 | | | | | | | | |
| Ox.-Bat. P&T | Avg | NSPS-1 | 1450 | 30 | | | | | | | | |
| | Max | PSNS-1 | | 70 | | | | | | | | |
| Ox. -Cont. | Avg | NSPS-1 | 225 | 30 | | | | | | | | |
| | Max | PSNS-1 | | 70 | | | | | | | | |
| Red.-Bat. | Avg | NSPS-1 | 100 | 30 | | | | | | | | |
| | Max | PSNS-1 | | 70 | | | | | | | | |
| Red.-Cont | Avg | NSPS-1 | 1800 | 30 | | | | | | | | |
| | Max | PSNS-1 | | 70 | | | | | | | | |
| Sulfuric Acid Pickling | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | NSPS-1 | 50 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Bar, Billet, Bloom | Avg | NSPS-1 | 30 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Strip, Sheet, Plate | Avg | NSPS-1 | 40 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| P&T & Oth. | Avg | NSPS-1 | 70 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Fume Scrub.$^{(5)}$ | Avg | NSPS-1 | 15 GPM | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| HCl Acid Pickling | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | NSPS-1 | 60 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Strip, Sheet & Plate | Avg | NSPS-1 | 40 | 30 | 70$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Pipe, Tube & Other | Avg | NSPS-1 | 110 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | 70 | 30$^{(4)}$ | | | | | | | | |
| Fume Scrubber$^{(5)}$ | Avg | NSPS-1 | 15 GPM | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Combination Acid Pickling | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | NSPS-1 | 70 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | 70 | 30$^{(4)}$ | | | | | | | | |
| Bar, Billet, Bloom | Avg | NSPS-1 | 40 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | 70 | 30$^{(4)}$ | | | | | | | | |
| Cont-S, S&P | Avg | NSPS-1 | 170 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Bat.-S, S&P | Avg | NSPS-1 | 60 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| P&T & Oth. | Avg | NSPS-1 | 100 | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | | 70 | 30$^{(4)}$ | | | | | | | |
| Fume Scrub.$^{(5)}$ | Avg | NSPS-1 | 15 GPM | 30 | 10$^{(4)}$ | | | | | | | |
| | Max | PSNS-1 | 70 | 30$^{(4)}$ | | | | | | | | |
| Cold Forming | | | | | | | | | | | | |
| CR: Recir-Sing | Avg | NSPS-1 | 5 | 30 | 10 | | | | | - | | - |
| | Max | PSNS-1 | | 60 | 25 | | | | | 0.1 | | 0.15 |
| CR: Recir-Multi | Avg | NSPS-1 | 10 | 30 | 10 | | | | | - | | - |
| | Max | PSNS-1 | | 60 | 25 | | | | | 0.1 | | 0.15 |
| CR: Comb. | Avg | NSPS-1 | 130 | 30 | 10 | | | | | - | | - |
| | Max | PSNS-1 | | 60 | 25 | | | | | 0.1 | | 0.15 |

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2 CONT.

| Subcategory | | PSNS/NSPS Effluent Concentrations (mg/1) Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
|---|---|---|---|---|---|---|---|
| Salt Bath-Descal. | | | | | | | |
| Ox.-Bat. S&P | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Ox.-Bat. R&W | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Ox.-Bat. P&T | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Ox. -Cont. | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Red.-Bat. | Avg | 0.4 | 0.25 | | 0.3 | | |
| | Max | 1.0 | 0.75 | | 0.9 | | |
| Red.-Cont | Avg | 0.4 | 0.25 | | 0.3 | | |
| | Max | 1.0 | 0.75 | | 0.9 | | |
| Sulfuric Acid Pickling | | | | | | | |
| Rod, Wire, Coil | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Bar, Billet, Bloom | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Strip, Sheet, Plate | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| P&T & Oth. | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Fume Scrub.(5) | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| HCl Acid Pickling | | | | | | | |
| Rod, Wire, Coil | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Strip, Sheet & Plate | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Pipe, Tube & Other | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Fume Scrubber(5) | Avg | | | 0.15 | | 0.1 | |
| | Max | | | 0.45 | | 0.3 | |
| Combination Acid Pickling | | | | | | | |
| Rod, Wire, Coil | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Bar, Billet, Bloom | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Cont-S, S&P | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Bat.-S, S&P | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| P&T & Oth. | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Fume Scrub.(5) | Avg | 0.4 | | | 0.3 | | |
| | Max | 1.0 | | | 0.9 | | |
| Cold Forming | | | | | | | |
| CR: Recir-Sing | Avg | 0.4(6) | | 0.15 | 0.3 | 0.1 | |
| | Max | 1.0(6) | | 0.45 | 0.9 | 0.3 | |
| CR: Recir-Multi | Avg | 0.4(6) | | 0.15 | 0.3 | 0.1 | |
| | Max | 1.0(6) | | 0.45 | 0.9 | 0.3 | |
| CR: Comb. | Avg | 0.4(6) | | 0.15 | 0.3 | 0.1 | |
| | Max | 1.0(6) | | 0.45 | 0.9 | 0.3 | |

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| Subcategory | | Selected Option | Discharge Flow (GPT) | PSNS/NSPS Effluent Concentrations (mg/l) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TSS$^{(1)}$ | O & G$^{(1)}$ | Ammonia | Chlorine$^{(1)}$ | Phenol (4AAP) | Toxic Organics (4) | (55) | (73) | (85) |
| Cold Forming Cont. | | | | | | | | | | | | |
| CR: DA-Sing. | Avg | NSPS-1 | 25 | 30 | 10 | | | | | - | | - |
| | Max | PSNS-1 | | 60 | 25 | | | | | 0.1 | | 0.15 |
| CR: DA-Multi. | Avg | NSPS-1 | 290 | 30 | 10 | | | | | - | | - |
| | Max | PSNS-1 | | 60 | 25 | | | | | 0.1 | | 0.15 |
| P&T | Avg | BPT | 0 | | | | | | | | | |
| | Max | | | | | | | | | | | |
| Alkaline Cleaning$^{(2)}$ | | | | | | | | | | | | |
| Batch & Cont. | Avg | NSPS-1 | 50 | 30 | 10 | | | | | | | |
| | Max | | | 70 | 30 | | | | | | | |
| Hot Coating Inc. all coat | | | | | | | | | | | | |
| S, S&Misc. wo/scrub. | Avg | NSPS-1 | 150 | 30 | 10 | | | | | | | |
| | Max | PSNS-1 | | 70 | 30 | | | | | | | |
| W/Fast wo/scrub | Avg | NSPS-1 | 600 | 30 | 10 | | | | | | | |
| | Max | PSNS-1 | | 70 | 30 | | | | | | | |
| Fume Scrub.$^{(5)}$ | Avg | NSPS-1 | 15 GPM | 30 | 10 | | | | | | | |
| | Max | PSNS-1 | | 70 | 30 | | | | | | | |

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3 CONT.

| Subcategory | | PSNS/NSPS Effluent Concentrations (mg/l) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| Cold Forming Cont. | | | | | | | |
| CR: DA-Sing. | Avg | 0.4(6) | | 0.15 | 0.3(6) | 0.1 | |
| | Max | 1.0(6) | | 0.45 | 0.9(6) | 0.3 | |
| CR: DA-Multi. | Avg | 0.4(6) | | 0.15 | 0.3(6) | 0.1 | |
| | Max | 1.0(6) | | 0.45 | 0.9(6) | 0.3 | |
| P&T | Avg | | | | | | |
| | Max | | | | | | |
| Alkaline Cleaning(2) | | | | | | | |
| Batch & Cont. | Avg | | | | | | |
| | Max | | | | | | |
| Hot Coating (All coating operations) | | | | | | | |
| S, S&Misc. wo/scurb. | Avg | | | 0.15 | | 0.1 | 0.02(7) |
| | Max | | | 0.45 | | 0.3 | 0.06(7) |
| W/Fast wo/scrub | Avg | | | 0.15 | | 0.1 | 0.02(7) |
| | Max | | | 0.45 | | 0.3 | 0.06(7) |
| Fume Scrub.(5) | Avg | | | 0.15 | | 0.1 | 0.02(7) |
| | Max | | | 0.45 | | 0.3 | 0.06(7) |

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NOTE: pH is also regulated in all subcategories and is limited to 6.0 - 9.0 standard units.

(1) This pollutant is limited only at NSPS.
(2) These values apply to the NSPS treatment level.
(3) These values apply to the PSNS treatment level.
(4) This pollutant is allowed only when these wastes are treated in combination with cold rolling mill wastes.
(5) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
(6) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(7) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-6

PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY

| Subcategory | | Selected Option | Discharge Flow (GPT) | PSNS/NSPS (kg/kkg x $10^{-5}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Toxic Organics | | | |
| | | | | TSS[1] | O & G[1] | Ammonia | Chlorine[1] | Phenol (4AAP) | (4) | (55) | (73) | (85) |
| Cokemaking | | | | | | | | | | | | |
| Iron & Steel[2] | Avg | NSPS-1 | 153 | 8940 | - | 1600 | | 3.19 | - | - | - | |
| | Max | | | 17200 | 638 | 5430 | | 6.38 | 3.19 | 3.19 | 3.19 | |
| Iron & Steel[3] | Avg | PSNS-1 | 103 | | | 3220 | | 2150 | | | | |
| | Max | | | | | 6450 | | 4390 | | | | |
| Merchant[2] | Avg | NSPS-1 | 170 | 9930 | - | 1770 | | 3.55 | - | - | - | |
| | Max | | | 19200 | 709 | 6030 | | 7.09 | 3.55 | 3.55 | 3.55 | |
| Merchant[3] | Avg | PSNS-1 | 120 | | | 3750 | | 2500 | | | | |
| | Max | | | | | 7510 | | 5010 | | | | |
| Beehive | Avg | BPT Only | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| Sintering | Avg | NSPS-1 | 120 | 751 | - | 501 | - | 5.01 | | | | |
| | Max | PSNS-2 | | 2000 | 501 | 1500 | 25.0 | 10.0 | | | | |
| Ironmaking | | | | | | | | | | | | |
| Iron | Avg | NSPS-5 | 70 | 438 | - | 292 | - | 2.92 | | | | |
| | Max | PSNS-5 | | 1170 | 292 | 876 | 14.6 | 5.84 | | | | |
| Ferromanganese | Avg | Reserved | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| Steelmaking | | | | | | | | | | | | |
| BOF:Semi-Wet | Avg | Reserved | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| BOF:Wet-Open Combustion | Avg | NSPS-2 | 110 | 1150 | | | | | | | | |
| | Max | PSNS-3 | | 3210 | | | | | | | | |
| BOF:Wet-Supp. Combustion | Avg | NSPS-2 | 50 | 522 | | | | | | | | |
| | Max | PSNS-3 | | 1460 | | | | | | | | |
| Open Hearth-Wet | Avg | NSPS-2 | 110 | 1150 | | | | | | | | |
| | Max | PSNS-3 | | 3210 | | | | | | | | |
| EAF:Semi-Wet | Avg | Reserved | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| EAF:Wet | Avg | NSPS-2 | 110 | 1150 | | | | | | | | |
| | Max | PSNS-3 | | 3210 | | | | | | | | |
| Vacuum Degassing | Avg | NSPS-1 | 25 | 261 | | | | | | | | |
| | Max | PSNS-2 | | 730 | | | | | | | | |
| Continuous Casting | Avg | NSPS-1 | 25 | 261 | 104 | | | | | | | |
| | Max | PSNS-1 | | 730 | 313 | | | | | | | |
| Hot Forming | | | | | | | | | | | | |
| Prim.: C&S w/os | Avg | NSPS-1 | 90 | 563 | - | | | | | | | |
| | Max | | | 1500 | 375 | | | | | | | |
| Prim: C&S w/s | Avg | NSPS-1 | 140 | 876 | - | | | | | | | |
| | Max | | | 2340 | 584 | | | | | | | |
| Sect: Carb. | Avg | NSPS-1 | 200 | 1250 | - | | | | | | | |
| | Max | | | 3340 | 834 | | | | | | | |
| Sect: Spec. | Avg | NSPS-1 | 130 | 814 | - | | | | | | | |
| | Max | | | 2170 | 542 | | | | | | | |
| Flat: HS&S (C&S) | Avg | NSPS-1 | 260 | 1630 | - | | | | | | | |
| | Max | | | 4340 | 1080 | | | | | | | |
| Flat: Plate-Carb. | Avg | NSPS-1 | 140 | 876 | - | | | | | | | |
| | Max | | | 2340 | 584 | | | | | | | |
| Flat: Plate-Spec. | Avg | NSPS-1 | 60 | 375 | - | | | | | | | |
| | Max | | | 1000 | 250 | | | | | | | |
| Pipe & Tube | Avg | NSPS-1 | 220 | 1380 | - | | | | | | | |
| | Max | | | 3670 | 918 | | | | | | | |

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 1 CONT.

| Subcategory | | PSNS/NSPS (kg/kkg x $10^{-5}$)<br>Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
|---|---|---|---|---|---|---|---|
| Cokemaking | | | | | | | |
| Iron & Steel(2) | Avg | | 351 | | | | |
| | Max | | 638 | | | | |
| Iron & Steel(3) | Avg | | 859 | | | | |
| | Max | | 1720 | | | | |
| Merchant(2) | Avg | | 390 | | | | |
| | Max | | 709 | | | | |
| Merchant(3) | Avg | | 1000 | | | | |
| | Max | | 2000 | | | | |
| Beehive | Avg | | | | | | |
| | Max | | | | | | |
| Sintering | Avg | | 50.1 | 12.5 | | 15.0 | |
| | Max | | 100 | 37.5 | | 45.1 | |
| Ironmaking | | | | | | | |
| Iron | Avg | | 29.2 | 7.30 | | 8.76 | |
| | Max | | 58.4 | 21.9 | | 26.3 | |
| Ferromanganese | Avg | | | | | | |
| | Max | | | | | | |
| Steelmaking | | | | | | | |
| BOF: Semi-Wet | Avg | | | | | | |
| | Max | | | | | | |
| BOF: Wet-Open Combustion | Avg | | | 13.8 | | 20.7 | |
| | Max | | | 41.3 | | 62.0 | |
| BOF:Wet-Supp. Combustion | Avg | | | 6.26 | | 9.39 | |
| | Max | | | 18.8 | | 28.2 | |
| Open Hearth Wet | Avg | | | 13.8 | | 20.7 | |
| | Max | | | 41.3 | | 62.0 | |
| EAF: Semi-Wet | Avg | | | | | | |
| | Max | | | | | | |
| EAF: Wet | Avg | | | 13.8 | | 20.7 | |
| | Max | | | 41.3 | | 62.0 | |
| Vacuum Degassing | Avg | | | 3.13 | | 4.69 | |
| | Max | | | 9.39 | | 14.1 | |
| Continuous Casting | Avg | | | 3.13 | | 4.69 | |
| | Max | | | 9.39 | | 14.1 | |
| Hot Forming | | | | | | | |
| Prim.: C&S w/os | Avg | | | | | | |
| | Max | | | | | | |
| Prim.: C&S w/s | Avg | | | | | | |
| | Max | | | | | | |
| Sect.: Carb. | Avg | | | | | | |
| | Max | | | | | | |
| Sect.: Spec. | Avg | | | | | | |
| | Max | | | | | | |
| Flat: HS&S (C&S) | Avg | | | | | | |
| | Max | | | | | | |
| Flat: Plate-Carb. | Avg | | | | | | |
| | Max | | | | | | |
| Flat: Plate-Spec. | Avg | | | | | | |
| | Max | | | | | | |
| Pipe & Tube | Avg | | | | | | |
| | Max | | | | | | |

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

| Subcategory | | Selected Option | Discharge Flow (GPT) | PSNS/NSPS (kg/kkg x 10^-5) | | | | | Toxic Organics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TSS(1) | O & G(1) | Ammonia | Chlorine(1) | Phenol (4AAP) | (4) | (55) | (73) | (85) |
| Salt Bath-Descal. | | | | | | | | | | | | |
| Ox.-Bat. S&P | Avg | NSPS-1 | 700 | 8760 | | | | | | | | |
| | Max | PSNS-1 | | 20400 | | | | | | | | |
| Ox.-Bat. R&W | Avg | NSPS-1 | 420 | 5260 | | | | | | | | |
| | Max | PSNS-1 | | 12300 | | | | | | | | |
| Ox.-Bat. P&T | Avg | NSPS-1 | 1700 | 21300 | | | | | | | | |
| | Max | PSNS-1 | | 49600 | | | | | | | | |
| Ox.-Cont. | Avg | NSPS-1 | 330 | 4130 | | | | | | | | |
| | Max | PSNS-1 | | 9640 | | | | | | | | |
| Red.-Bat. | Avg | NSPS-1 | 325 | 4070 | | | | | | | | |
| | Max | PSNS-1 | | 9490 | | | | | | | | |
| Red.-Cont. | Avg | NSPS-1 | 1820 | 22800 | | | | | | | | |
| | Max | PSNS-1 | | 53200 | | | | | | | | |
| Sulf. Acid Pickl. | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | NSPS-1 | 50 | 626 | 209(4) | | | | | | | |
| | Max | PSNS-1 | | 1460 | 626(4) | | | | | | | |
| Bar, Billet, Bloom | Avg | NSPS-1 | 30 | 375 | 125(4) | | | | | | | |
| | Max | PSNS-1 | | 876 | 375(4) | | | | | | | |
| Strip, Sheet, Plate | Avg | NSPS-1 | 40 | 501 | 167(4) | | | | | | | |
| | Max | PSNS-1 | | 1170 | 501(4) | | | | | | | |
| Pipe, Tube & Other | Avg | NSPS-1 | 70 | 876 | 292(4) | | | | | | | |
| | Max | PSNS-1 | | 2040 | 876(4) | | | | | | | |
| Fume Scrubber(5) | Avg | NSPS-1 | 15 GPM | 245000 | 81900(4) | | | | | | | |
| | Max | PSNS-1 | | 572000 | 245000(4) | | | | | | | |
| HCl Acid Pickl. | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | NSPS-1 | 60 | 751 | 250(4) | | | | | | | |
| | Max | PSNS-1 | | 1750 | 751(4) | | | | | | | |
| Strip, Sheet, Plate | Avg | NSPS-1 | 40 | 501 | 167(4) | | | | | | | |
| | Max | PSNS-1 | | 1170 | 501(4) | | | | | | | |
| Pipe, Tube & Other | Avg | NSPS-1 | 110 | 1380 | 459(4) | | | | | | | |
| | Max | PSNS-1 | | 3210 | 1380(4) | | | | | | | |
| Fume Scrubber(5) | Avg | NSPS-1 | 15 GPM | 245000 | 81900(4) | | | | | | | |
| | Max | PSNS-1 | | 572000 | 245000(4) | | | | | | | |
| Comb-Acid Pickl. | | | | | | | | | | | | |
| Rod, Wire, Coil | Avg | NSPS-1 | 70 | 876 | 292(4) | | | | | | | |
| | Max | PSNS-1 | | 2040 | 876(4) | | | | | | | |
| Bar, Billet, Bloom | Avg | NSPS-1 | 40 | 501 | 167(4) | | | | | | | |
| | Max | PSNS-1 | | 1170 | 501(4) | | | | | | | |
| Cont.-S, S&P | Avg | NSPS-1 | 170 | 2130 | 709(4) | | | | | | | |
| | Max | PSNS-1 | | 4960 | 2130(4) | | | | | | | |
| Bat.-S, S&P | Avg | NSPS-1 | 60 | 751 | 250(4) | | | | | | | |
| | Max | PSNS-1 | | 1750 | 751(4) | | | | | | | |
| Pipe, Tube & Other | Avg | NSPS-1 | 100 | 1250 | 417(4) | | | | | | | |
| | Max | PSNS-1 | | 2920 | 1250(4) | | | | | | | |
| Fume Scrubber(5) | Avg | NSPS-1 | 15 GPM | 245000 | 81900(4) | | | | | | | |
| | Max | PSNS-1 | | 572000 | 245000(4) | | | | | | | |
| Cold Forming | | | | | | | | | | | | |
| CR: Recir-Sing. | Avg | NSPS-1 | 5 | 62.6 | 20.9 | | | | | - | | - |
| | Max | PSNS-1 | | 125 | 52.2 | | | | | 0.21 | | 0.31 |
| CR: Recir-Multi. | Avg | NSPS-1 | 10 | 125 | 41.7 | | | | | - | | - |
| | Max | PSNS-1 | | 250 | 104 | | | | | 0.42 | | 0.63 |
| CR: Comb. | Avg | NSPS-1 | 130 | 1630 | 542 | | | | | - | | - |
| | Max | PSNS-1 | | 3250 | 1360 | | | | | 5.42 | | 8.13 |

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2 CONT.

| Subcategory | | PSNS/NSPS (kg/kkg x $10^{-5}$)<br>Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
|---|---|---|---|---|---|---|---|
| Salt Bath-Descal. | | | | | | | |
| Ox.-Bat. S&P | Avg | 117 | | | 87.6 | | |
| | Max | 292 | | | 263 | | |
| Ox.-Bat. R&W | Avg | 70.1 | | | 52.6 | | |
| | Max | 175 | | | 158 | | |
| Ox.-Bat. P&T | Avg | 284 | | | 213 | | |
| | Max | 709 | | | 638 | | |
| Ox.-Bat. Cont. | Avg | 55.1 | | | 41.3 | | |
| | Max | 138 | | | 124 | | |
| Red.-Bat. | Avg | 54.2 | 33.9 | | 40.7 | | |
| | Max | 136 | 102 | | 122 | | |
| Red.Cont. | Avg | 304 | 190 | | 228 | | |
| | Max | 759 | 569 | | 683 | | |
| Sulf. Acid Pickl. | | | | | | | |
| Rod, Wire, Coil | Avg | | | 3.13 | | 2.09 | |
| | Max | | | 9.39 | | 6.26 | |
| Bar, Billet, Bloom | Avg | | | 1.88 | | 1.25 | |
| | Max | | | 5.63 | | 3.75 | |
| Strip, Sheet, Plate | Avg | | | 2.50 | | 1.67 | |
| | Max | | | 7.51 | | 5.01 | |
| Pipe, Tube & Other | Avg | | | 4.38 | | 2.92 | |
| | Max | | | 13.1 | | 8.76 | |
| Fume Scrubber(5) | Avg | | | 1230 | | 819 | |
| | Max | | | 3680 | | 2450 | |
| HCl Acid Pickl. | | | | | | | |
| Rod, Wire, Coil | Avg | | | 3.75 | | 2.50 | |
| | Max | | | 11.3 | | 7.51 | |
| Strip, Sheet, Plate | Avg | | | 2.50 | | 1.67 | |
| | Max | | | 7.51 | | 5.01 | |
| Pipe, Tube & Other | Avg | | | 6.88 | | 4.59 | |
| | Max | | | 20.7 | | 13.8 | |
| Fume Scrubber(5) | Avg | | | 1230 | | 819 | |
| | Max | | | 3680 | | 2450 | |
| Comb-Acid Pickl. | | | | | | | |
| Rod, Wire, Coil | Avg | 11.7 | | | 8.76 | | |
| | Max | 29.2 | | | 26.3 | | |
| Bar, Billet, Bloom | Avg | 6.68 | | | 5.01 | | |
| | Max | 16.7 | | | 15.0 | | |
| Cont.-S, S&P | Avg | 28.4 | | | 21.3 | | |
| | Max | 70.9 | | | 63.8 | | |
| Bat.-S, S&P | Avg | 10.0 | | | 7.51 | | |
| | Max | 25.0 | | | 22.5 | | |
| Pipe, Tube & Other | Avg | 16.7 | | | 12.5 | | |
| | Max | 41.7 | | | 37.5 | | |
| Fume Scrubber(5) | Avg | 3270 | | | 2450 | | |
| | Max | 8190 | | | 7350 | | |
| Cold Forming | | | | | | | |
| CR: Recir-Sing. | Avg | 0.83(6) | | 0.31 | 0.63(6) | 0.21 | |
| | Max | 2.09(6) | | 0.94 | 1.88(6) | 0.63 | |
| CR: Recir-Multi. | Avg | 1.67(6) | | 0.63 | 1.25(6) | 0.42 | |
| | Max | 4.17(6) | | 1.88 | 3.75(6) | 1.25 | |
| CR: Comb. | Avg | 21.7(6) | | 8.14 | 16.3(6) | 5.42 | |
| | Max | 54.2(6) | | 24.4 | 48.8(6) | 16.3 | |

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| | | | | PSNS/NSPS (kg/kkg x $10^{-5}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Toxic Organics | | |
| Subcategory | | Selected Option | Discharge Flow (GPT) | TSS$^{(1)}$ | O & G$^{(1)}$ | Ammonia | Chlorine$^{(1)}$ | Phenol (4AAP) | (4) | (55) | (73) | (85) |
| Cold Forming | | | | | | | | | | | | |
| CR: DA-Sing. | Avg | NSPS-1 | 25 | 313 | 104 | | | | | - | | - |
| | Max | PSNS-1 | | 626 | 261 | | | | | 1.04 | | 1.56 |
| CR: DA-Multi. | Avg | NSPS-1 | 290 | 3630 | 1210 | | | | | - | | - |
| | Max | PSNS-1 | | 7260 | 3020 | | | | | 12.1 | | 18.1 |
| Pipe & Tube | Avg | BPT Only | | | | | | | | | | |
| | Max | | | | | | | | | | | |
| Alkaline Cleaning$^{(2)}$ Bat. & Cont. | Avg | NSPS-1 | 50 | 626 | 209 | | | | | | | |
| | Max | | | 1460 | 626 | | | | | | | |
| Hot Coating-inc. all coat S, S&Misc. wo/scrub | Avg | NSPS-1 | 150 | 1880 | 626 | | | | | | | |
| | Max | PSNS-1 | | 4380 | 1880 | | | | | | | |
| W/Fast wo/scrub | Avg | NSPS-1 | 600 | 7510 | 2500 | | | | | | | |
| | Max | PSNS-1 | | 17500 | 7510 | | | | | | | |
| Fume Scrubber$^{(5)}$ | Avg | NSPS-1 | 15 GPM | 245000 | 81900 | | | | | | | |
| | Max | PSNS-1 | | 572000 | 245000 | | | | | | | |

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3 CONT.

|  |  | PSNS/NSPS (kg/kkg x $10^{-5}$) |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| Subcategory |  | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| Cold Forming |  |  |  |  |  |  |  |
| CR: DA-Sing. | Avg | 4.17(6) |  | 1.56 | 3.13(6) | 1.04 |  |
|  | Max | 10.4(6) |  | 4.69 | 9.39(6) | 3.13 |  |
| CR: DA-Multi. | Avg | 48.4(6) |  | 18.1 | 36.3(6) | 12.1 |  |
|  | Max | 121(6) |  | 54.4 | 109(6) | 36.3 |  |
| Pipe & Tube | Avg |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |
| Alkaline Cleaning |  |  |  |  |  |  |  |
| Bat. & Cont. | Avg |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |
| Hot Coat-inc. all coat |  |  |  |  |  |  |  |
| S, S&Misc. wo/scrub | Avg |  |  | 9.39 |  | 6.26 | 1.25(7) |
|  | Max |  |  | 28.2 |  | 18.8 | 3.75(7) |
| W/Fast wo/scrub | Avg |  |  | 37.5 |  | 25.0 | 5.01(7) |
|  | Max |  |  | 113 |  | 75.1 | 15.0(7) |
| Fume Scrubbers(5) | Avg |  |  | 1230 |  | 819 | 163(7) |
|  | Max |  |  | 3680 |  | 2450 | 490(7) |

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NOTE: pH is also regulated in all subcategories and is limited to 6.0 - 9.0 standard units.

(1) This pollutant applies only to the NSPS treatment level.

(2) These values apply to the NSPS treatment level.

(3) These values apply to the PSNS treatment level.

(4) This load is allowed only when these wastes are treated in combination with cold rolling mill wastes.

(5) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. The load is expressed in kg/day x $10^{-5}$.

(6) This load shall be applied in lieu of those for lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.

(7) The load for hexavalent chromium shall apply only to those galvanizing operations which discharge wastewater from a chromate rinse step.

TABLE I-7

PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY

| | | | | PSES Effluent Concentration (mg/l) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcategory | | Option Selected | Discharge Flow (GPT) | Ammonia | Phenal (4AAP) | CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | Toxic Organics 55 | Toxic Organics 85 |
| Cokemaking | | | | | | | | | | | | | |
| Iron & Steel | Avg | 1 | 103 | 75 | 50 | 20 | | | | | | | |
| | Max | | | 150 | 100 | 40 | | | | | | | |
| Merchant | Avg | 1 | 120 | 75 | 50 | 20 | | | | | | | |
| | Max | | | 150 | 100 | 40 | | | | | | | |
| Beehive | Avg | BPT | 0 | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Sintering | Avg | 2 | 120 | 10 | 0.1 | 1 | | | | 0.3 | 0.25 | | |
| | Max | | | 30 | 0.2 | 2 | | | | 0.9 | 0.75 | | |
| Ironmaking | | | | | | | | | | | | | |
| Iron | Avg | 5 | 70 | 10 | 0.1 | 1 | | | | 0.3 | 0.25 | | |
| | Max | | | 30 | 0.2 | 2 | | | | 0.9 | 0.75 | | |
| Ferromanganese | Avg | Reserved | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Steelmaking | | | | | | | | | | | | | |
| BOF:Semi-Wet | Avg | BPT | 0 | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| BOF:Wet-Open Combustion | Avg | 3 | 110 | | | | | | | 0.45 | 0.3 | | |
| | Max | | | | | | | | | 1.35 | 0.9 | | |
| BOF:Wet-Suppressed Combustion | Avg | 3 | 50 | | | | | | | 0.45 | 0.3 | | |
| | Max | | | | | | | | | 1.35 | 0.9 | | |
| Open Hearth-Wet | Avg | 3 | 110 | | | | | | | 0.45 | 0.3 | | |
| | Max | | | | | | | | | 1.35 | 0.9 | | |
| Elec. Arc Furnace: Semi-Wet | Avg | BPT | 0 | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Elec. Arc Furnace: Wet | Avg | 3 | 110 | | | | | | | 0.45 | 0.3 | | |
| | Max | | | | | | | | | 1.35 | 0.9 | | |
| Vacuum Degassing | Avg | 2 | 25 | | | | | | | 0.45 | 0.3 | | |
| | Max | | | | | | | | | 1.35 | 0.9 | | |
| Continuous Casting | Avg | 2 | 25 | | | | | | | 0.45 | 0.3 | | |
| | Max | | | | | | | | | 1.35 | 0.9 | | |

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

| Subcategory | | Option Selected | Discharge Flow (GPT) | PSES Effluent Concentration (mg/l) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ammonia | Phenol (4AAP) | Organics CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | Toxic Organics 55 | 85 |
| Hot Forming | | | | | | | | | | | | | |
| Primary:Carbon & Spec. w/o scarf. | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Primary:Carbon & Spec. w/ scarf. | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Section:Carbon | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Section: Specialty | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Flat:Hot Strip & Sheet (Carbon & Specialty) | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Flat:Plate-Carbon | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Flat:Plate-Spec. | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Pipe & Tube | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | |
| | Max | | | | | | | | | | | | |
| Salt Bath Descaling | | | | | | | | | | | | | |
| Oxidizing-Batch, Sheet & Plate | Avg | 1 | 700 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Oxidizing-Batch, Rod & Wire | Avg | 1 | 420 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Oxidizing-Batch, Pipe & Tube | Avg | 1 | 1700 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Oxidizing-Cont. | Avg | 1 | 330 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Reducing-Batch | Avg | 1 | 325 | | 0.25 | | | 0.4 | 0.3 | | | | |
| | Max | | | | 0.75 | | | 1.0 | 0.9 | | | | |
| Reducing-Continuous | Avg | 1 | 1820 | | 0.25 | | | 0.4 | 0.3 | | | | |
| | Max | | | | 0.75 | | | 1.0 | 0.9 | | | | |

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

| Subcategory | | Option Selected | Discharge Flow (GPT) | PSES Effluent Concentration (mg/l) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ammonia | Phenol (4AAP) | Organics CN-T | $Cr^{+6}$ | Cr | Ni | Zn | Pb | Toxic Organics 55 | 85 |
| Sulfuric Acid Pickl. | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 1 | 280 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Bar, Billet & Bloom | Avg | 1 | 90 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Strip, Sheet & Plate | Avg | 1 | 180 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Pipe, Tube & Other | Avg | 1 | 500 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Fume Scrubber(1) | Avg | 1 | 15 GPM | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| HCl Acid Pickl. | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 1 | 490 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Strip, Sheet & Plate | Avg | 1 | 280 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Pipe, Tube & Other | Avg | 1 | 1020 | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Fume Scrubber(1) | Avg | 1 | 15 GPM | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Acid Regeneration | Avg | 1 | 100 GPM | | | | | | | 0.1 | 0.15 | | |
| | Max | | | | | | | | | 0.3 | 0.45 | | |
| Combination Acid Pickl. | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 1 | 510 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Bar, Billet & Bloom | Avg | 1 | 230 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Cont.-Strip, Sheet Sheet & Plate | Avg | 1 | 1500 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |
| Batch-Strip, Sheet & Plate | Avg | 1 | 460 | | | | | 0.4 | 0.3 | | | | |
| | Max | | | | | | | 1.0 | 0.9 | | | | |

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 4

|  |  |  |  | PSES Effluent Concentration (mg/1) |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | Organics |  |  |  |  |  | Toxic Organics |  |
| Subcategory |  | Option Selected | Discharge Flow (GPT) | Ammonia | Phenol (4AAP) | CN-T | Cr$^{+6}$ | Cr | Ni | Zn | Pb | 55 | 85 |
| Pipe, Tube & Other Products | Avg | 1 | 770 |  |  |  |  | 0.4 | 0.3 |  |  |  |  |
|  | Max |  |  |  |  |  |  | 1.0 | 0.9 |  |  |  |  |
| Fume Scrubber$^{(1)}$ | Avg | 1 | 15 GPM |  |  |  |  | 0.4 | 0.3 |  |  |  |  |
|  | Max |  |  |  |  |  |  | 1.0 | 0.9 |  |  |  |  |
| Cold Forming |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cold Rolling:Recir Single Stand | Avg | 1 | 5 |  |  |  |  | 0.4$^{(2)}$ | 0.3$^{(2)}$ | 0.1 | 0.15 | - | - |
|  | Max |  |  |  |  |  |  | 1.0$^{(2)}$ | 0.9$^{(2)}$ | 0.3 | 0.45 | 0.1 | 0.15 |
| Cold Rolling:Recir Multi Stand | Avg | 1 | 25 |  |  |  |  | 0.4$^{(2)}$ | 0.3$^{(2)}$ | 0.1 | 0.15 | - | - |
|  | Max |  |  |  |  |  |  | 1.0$^{(2)}$ | 0.9$^{(2)}$ | 0.3 | 0.45 | 0.1 | 0.15 |
| Cold Rolling: Combination | Avg | 1 | 300 |  |  |  |  | 0.4$^{(2)}$ | 0.3$^{(2)}$ | 0.1 | 0.15 | - | - |
|  | Max |  |  |  |  |  |  | 1.0$^{(2)}$ | 0.9 | 0.3 | 0.45 | 0.1 | 0.15 |
| Cold Rolling:Direct Appl. Single Stand | Avg | 1 | 90 |  |  |  |  | 0.4$^{(2)}$ | 0.3$^{(2)}$ | 0.1 | 0.15 | - | - |
|  | Max |  |  |  |  |  |  | 1.0$^{(2)}$ | 0.9$^{(2)}$ | 0.3 | 0.45 | 0.1 | 0.15 |
| Cold Rolling:Direct Appl. Multi Stand | Avg | 1 | 400 |  |  |  |  | 0.4$^{(2)}$ | 0.3$^{(2)}$ | 0.1 | 0.15 | - | - |
|  | Max |  |  |  |  |  |  | 1.0$^{(2)}$ | 0.9$^{(2)}$ | 0.3 | 0.45 | 0.1 | 0.15 |
| Pipe & Tube | Avg | BPT | 0 |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |
| Alkaline Cleaning |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Batch | Avg | Subject to General Pretreatment Standards |  |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |
| Continuous | Avg | Subject to General Pretreatment Standards |  |  |  |  |  |  |  |  |  |  |  |
|  | Max |  |  |  |  |  |  |  |  |  |  |  |  |
| Hot Coating (Includes all abating operations) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Strip/Sheet/Misc. wo/scrubbers | Avg | 2 | 600 |  |  |  | 0.02$^{(3)}$ |  | 0.1 |  | 0.15 |  |  |
|  | Max |  |  |  |  |  | 0.06$^{(3)}$ |  | 0.3 |  | 0.45 |  |  |
| Wire/Fasteners wo/scrubbers | Avg | 2 | 2400 |  |  |  | 0.02$^{(3)}$ |  | 0.1 |  | 0.15 |  |  |
|  | Max |  |  |  |  |  | 0.06$^{(3)}$ |  | 0.3 |  | 0.45 |  |  |
| Fume Scrubbers | Avg | 2 | 15 GPM |  |  |  | 0.02$^{(3)}$ |  | 0.1 |  | 0.15 |  |  |
|  | Max |  |  |  |  |  | 0.06$^{(3)}$ |  | 0.3 |  | 0.45 |  |  |

**TABLE I-7**
**PSES CONCENTRATION AND FLOW SUMMARY**
**IRON AND STEEL INDUSTRY**
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(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation

(2) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewates are treated with descaling or combination acid pickling wastewaters.

(3) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-8

PSES SUMMARY
IRON & STEEL INDUSTRY

| Subcategory | | Selected Option | Discharge Flow (GPT) | PSES (kg/kkg x $10^{-5}$) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ammonia | Chlorine | Phenol (4AAP) | Toxic Organics (55) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| **Cokemaking** | | | | | | | | | | | | | | |
| Iron & Steel | Avg | 1 | 103 | 3220 | | 2150 | | | | 859 | | | | |
| | Max | | | 6450 | | 4300 | | | | 1720 | | | | |
| Merchant | Avg | 1 | 120 | 3750 | | 2500 | | | | 1000 | | | | |
| | Max | | | 7510 | | 5010 | | | | 2000 | | | | |
| Beehive | Avg | BPT | 0 | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Sintering | Avg | 2 | 120 | 501 | | 5.01 | | | | 50.1 | 12.5 | | 15.0 | |
| | Max | | | 1500 | | 10.0 | | | | 100 | 37.5 | | 45.1 | |
| **Ironmaking** | | | | | | | | | | | | | | |
| Iron | Avg | 5 | 70 | 292 | | 2.92 | | | | 29.2 | 7.30 | | 8.76 | |
| | Max | | | 876 | | 5.84 | | | | 58.4 | 21.9 | | 26.3 | |
| Ferromanganese | Avg | Reserved | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| **Steelmaking** | | | | | | | | | | | | | | |
| BOF: Semi-Wet | Avg | BPT | 0 | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| BOF: Wet-Open | Avg | 3 | 110 | | | | | | | | 13.8 | | 20.7 | |
| | Max | | | | | | | | | | 41.3 | | 62.0 | |
| BOF: Wet-Suppressed | Avg | 3 | 50 | | | | | | | | 6.26 | | 9.39 | |
| | Max | | | | | | | | | | 18.8 | | 28.2 | |
| Open Hearth - Wet | Avg | 3 | 110 | | | | | | | | 13.8 | | 20.7 | |
| | Max | | | | | | | | | | 41.3 | | 62.0 | |
| EAF: Semi-Wet | Avg | BPT | 0 | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| EAF: Wet | Avg | 3 | 110 | | | | | | | | 13.8 | | 20.7 | |
| | Max | | | | | | | | | | 41.3 | | 62.0 | |
| Vacuum Degassing | Avg | 2 | 25 | | | | | | | | 3.13 | | 4.69 | |
| | Max | | | | | | | | | | 9.39 | | 14.1 | |
| Continuous Casting | Avg | 2 | 25 | | | | | | | | 3.13 | | 4.69 | |
| | Max | | | | | | | | | | 9.39 | | 14.1 | |
| **Hot Forming** | | | | | | | | | | | | | | |
| Prim.: C&S w/o s | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Prim.: C&S w/s | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Section: Carbon | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Section: Specialty | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |

TABLE I-8
PSES SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

| | | | | PSES (kg/kkg x $10^{-5}$) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Toxic Organics | | | | | | | |
| Subcategory | | Selected Option | Discharge Flow (GPT) | Ammonia | Chlorine | Phenol (4AAP) | (55) | (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
| Flat: HS&S (C&S) | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Flat: Plate-Carbon | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Flat: Plate-Specialty | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Pipe & Tube | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Salt Bath Descaling | | | | | | | | | | | | | | |
| Ox.-Bat. S&P | Avg | 1 | 700 | | | | | | 117 | | | 87.6 | | |
| | Max | | | | | | | | 292 | | | 263 | | |
| Ox.-Bat. R&W | Avg | 1 | 420 | | | | | | 70.1 | | | 52.6 | | |
| | Max | | | | | | | | 175 | | | 158 | | |
| Ox.-Bat. P&T | Avg | 1 | 1700 | | | | | | 284 | | | 213 | | |
| | Max | | | | | | | | 709 | | | 638 | | |
| Ox.-Cont. | Avg | 1 | 330 | | | | | | 55.1 | | | 41.3 | | |
| | Max | | | | | | | | 138 | | | 124 | | |
| Red.-Bat. | Avg | 1 | 325 | | | | | | 54.2 | 33.9 | | 40.7 | | |
| | Max | | | | | | | | 136 | 102 | | 122 | | |
| Red.-Cont. | Avg | 1 | 1820 | | | | | | 304 | 190 | | 228 | | |
| | Max | | | | | | | | 759 | 569 | | 683 | | |
| Sulfuric Acid Pickling | | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 1 | 280 | | | | | | | | 17.5 | | 11.7 | |
| | Max | | | | | | | | | | 52.6 | | 35.0 | |
| Bar, Billet & Bloom | Avg | 1 | 90 | | | | | | | | 5.63 | | 3.75 | |
| | Max | | | | | | | | | | 16.9 | | 11.3 | |
| Strip, Sheet & Plate | Avg | 1 | 180 | | | | | | | | 11.3 | | 7.51 | |
| | Max | | | | | | | | | | 33.8 | | 22.5 | |
| Pipe, Tube & Other | Avg | 1 | 500 | | | | | | | | 31.3 | | 20.9 | |
| | Max | | | | | | | | | | 93.9 | | 62.6 | |
| Fume Scrubber(1) | Avg | 1 | 15 GPM | | | | | | | | 1230 | | 819 | |
| | Max | | | | | | | | | | 3680 | | 2450 | |
| Hydrochloric Acid Pickling | | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 1 | 490 | | | | | | | | 30.7 | | 20.4 | |
| | Max | | | | | | | | | | 92.0 | | 61.3 | |
| Strip, Sheet & Plate | Avg | 1 | 280 | | | | | | | | 17.5 | | 11.7 | |
| | Max | | | | | | | | | | 52.6 | | 35.0 | |
| Pipe, Tube & Other | Avg | 1 | 1020 | | | | | | | | 63.8 | | 42.6 | |
| | Max | | | | | | | | | | 192 | | 128 | |
| Fume Scrubber(1) | Avg | 1 | 15 GPM | | | | | | | | 1230 | | 819 | |
| | Max | | | | | | | | | | 3680 | | 2450 | |
| Acid Regeneration(1) | Avg | 1 | 100 GPM | | | | | | | | 8190 | | 5450 | |
| | Max | | | | | | | | | | 24500 | | 16300 | |

TABLE I-8
PSES SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| Subcategory | | Selected Option | Discharge Flow (GPT) | PSES (kg/kkg x $10^{-5}$) Ammonia | Chlorine | Phenol (4AAP) | Toxic Organics (55) | Toxic Organics (85) | Cr (119) | CN(T) (121) | Pb (122) | Ni (124) | Zn (128) | $Cr^{+6}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Combination Acid Pickling | | | | | | | | | | | | | | |
| Rod, Wire & Coil | Avg | 1 | 510 | | | | | | 85.1 | | | 63.8 | | |
| | Max | | | | | | | | 213 | | | 192 | | |
| Bar, Billet & Bloom | Avg | 1 | 230 | | | | | | 38.4 | | | 28.8 | | |
| | Max | | | | | | | | 96.0 | | | 86.4 | | |
| Continuous-S, S&P | Avg | 1 | 1500 | | | | | | 250 | | | 188 | | |
| | Max | | | | | | | | 626 | | | 563 | | |
| Bat.-S, S&P | Avg | 1 | 460 | | | | | | 76.8 | | | 57.6 | | |
| | Max | | | | | | | | 192 | | | 173 | | |
| Pipe, Tube & Other | Avg | 1 | 770 | | | | | | 129 | | | 96.4 | | |
| | Max | | | | | | | | 322 | | | 289 | | |
| Fume Scrubber$^{(1)}$ | Avg | 1 | 15 GPM | | | | | | 3270 | | | 2450 | | |
| | Max | | | | | | | | 8190 | | | 7350 | | |
| Cold Forming | | | | | | | | | | | | | | |
| CR: Recir.-Single Stand | Avg | 1 | 5 | | | | - | - | 0.83$^{(2)}$ | | 0.31 | 0.63$^{(2)}$ | 0.21 | |
| | Max | | | | | | 0.21 | 0.31 | 2.09$^{(2)}$ | | 0.94 | 1.88$^{(2)}$ | 0.63 | |
| CR: Recir.-Multi Stand | Avg | 1 | 25 | | | | - | - | 4.17$^{(2)}$ | | 1.56 | 3.13$^{(2)}$ | 1.04 | |
| | Max | | | | | | 1.04 | 1.56 | 10.4$^{(2)}$ | | 4.69 | 9.39$^{(2)}$ | 3.13 | |
| CR: Combination | Avg | 1 | 300 | | | | - | - | 50.1$^{(2)}$ | | 18.8 | 37.5$^{(2)}$ | 12.5 | |
| | Max | | | | | | 12.5 | 18.8 | 125$^{(2)}$ | | 56.3 | 113$^{(2)}$ | 37.5 | |
| CR: DA-Single Stand | Avg | 1 | 90 | | | | - | - | 15.0$^{(2)}$ | | 5.63 | 11.3$^{(2)}$ | 3.75 | |
| | Max | | | | | | 3.75 | 5.63 | 37.5$^{(2)}$ | | 16.9 | 33.8$^{(2)}$ | 11.3 | |
| CR: DA-Multi Stand | Avg | 1 | 400 | | | | - | - | 66.8$^{(2)}$ | | 25.0 | 50.1$^{(2)}$ | 16.7 | |
| | Max | | | | | | 16.7 | 25.0 | 167$^{(2)}$ | | 75.1 | 150$^{(2)}$ | 50.1 | |
| Pipe & Tube | Avg | BPT | 0 | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Alkaline Cleaning | | | | | | | | | | | | | | |
| Batch | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Continuous | Avg | Subject to General Pretreatment Standards | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | |
| Hot Coating (includes all coating operations) | | | | | | | | | | | | | | |
| SS&M w/o scrubbers | Avg | 1 | 600 | | | | | | | | 37.5 | | 25.0 | 5.01$^{(3)}$ |
| | Max | | | | | | | | | | 113 | | 75.1 | 15.0$^{(3)}$ |
| W&F w/o scrubbers | Avg | 1 | 2400 | | | | | | | | 150 | | 100 | 20.0$^{(3)}$ |
| | Max | | | | | | | | | | 451 | | 300 | 60.1$^{(3)}$ |
| Fume Scrubbers$^{(1)}$ | Avg | 1 | 15 GPM | | | | | | | | 1230 | | 819 | 163$^{(3)}$ |
| | Max | | | | | | | | | | 3680 | | 2450 | 490$^{(3)}$ |

TABLE I-8
PSES SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. Load is expressed in kg/day x $10^{-3}$.
(2) This load shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with a descaling or combination acid pickling wastewaters.
(3) This load shall apply to those galvanizing operations which discharge wastewaters from a chromate rinse step.

## TABLE I-9

## BCT CONCENTRATION AND FLOW SUMMARY
## IRON & STEEL INDUSTRY

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Conc. (mg/l) | |
|---|---|---|---|---|
| | | | TSS | O&G |
| **Cokemaking** | | | | |
| Iron & Steel-Biological | Avg | 225 | 140 | 11.6 |
| | Max | | 270 | 34.8 |
| Iron & Steel-Physical Chemical | Avg | 175 | 179 | 14.9 |
| | Max | | 346 | 44.8 |
| Merchant-Biological | Avg | 240 | 140 | 11.6 |
| | Max | | 270 | 34.8 |
| Merchant-Physical Chemical | Avg | 190 | 177 | 14.6 |
| | Max | | 341 | 43.9 |
| Beehive | Avg | BPT | | |
| | Max | | | |
| **Sintering** | Avg | Reserved | | |
| | Max | | | |
| **Ironmaking** | | | | |
| Iron | Avg | Reserved | | |
| | Max | | | |
| Ferromanganese | Avg | Reserved | | |
| | Max | | | |
| **Steelmaking** | | | | |
| BOF: Semi-wet | Avg | BPT | | |
| | Max | | | |
| BOF: Wet-Open Combustion | Avg | Reserved | | |
| | Max | | | |
| BOF: Wet-Suppressed Combustion | Avg | Reserved | | |
| | Max | | | |
| Open Hearth: Wet | Avg | Reserved | | |
| | Max | | | |
| Electric Arc Furnace: Semi-wet | Avg | BPT | | |
| | Max | | | |
| Electric Arc Furnace: Wet | Avg | Reserved | | |
| | Max | | | |
| **Vacuum Degassing** | Avg | Reserved | | |
| | Max | | | |
| **Continuous Casting** | Avg | Reserved | | |
| | Max | | | |
| **Hot Forming** | | | | |
| Primary: Carbon & Spec. w/o Scarfers | Avg | 897 | 15 | - |
| | Max | | 40 | 10 |
| Primary: Carbon & Spec. w/Scarfers | Avg | 1326 | 15 | - |
| | Max | | 40 | 10 |
| Section: Carbon | Avg | 2142 | 15 | - |
| | Max | | 40 | 10 |
| Section: Specialty | Avg | 1344 | 15 | - |
| | Max | | 40 | 10 |

TABLE I-9
BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Conc. (mg/l) TSS | BCT Effluent Conc. (mg/l) O&G |
|---|---|---|---|---|
| Hot Forming | | | | |
| Flat: Hot Strip & Sheet (Carbon & Spec.) | Avg | 2560 | 15 | - |
| | Max | | 40 | 10 |
| Flat: Plate-Carbon | Avg | 1360 | 15 | - |
| | Max | | 40 | 10 |
| Flat: Plate-Specialty | Avg | 600 | 15 | - |
| | Max | | 40 | 10 |
| Pipe & Tube | Avg | 1270 | 15 | - |
| | Max | | 40 | 10 |
| Salt Bath Descaling | | | | |
| Oxidizing: Batch, Sheet & Plate | Avg | 700 | 30 | - |
| | Max | | 70 | - |
| Oxidizing: Batch, Rod & Wire | Avg | 420 | 30 | - |
| | Max | | 70 | - |
| Oxidizing: Batch, Pipe & Tube | Avg | 1700 | 30 | - |
| | Max | | 70 | - |
| Oxidizing: Continuous | Avg | 330 | 30 | - |
| | | | 70 | - |
| Reducing: Batch | Avg | 325 | 30 | - |
| | Max | | 70 | - |
| Reducing: Continuous | Avg | 1820 | 30 | - |
| | Max | | 70 | - |
| Sulfuric Acid Pickling | | | | |
| Rod, Wire & Coil | Avg | 280 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Bar, Billet & Bloom | Avg | 90 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Strip, Sheet & Plate | Avg | 180 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Pipe, Tube & Other | Avg | 500 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Fume Scrubber$^{(2)}$ | Avg | 15 GPM | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Hydrochloric Acid Pickling | | | | |
| Rod, Wire & Coil | Avg | 490 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Strip, Sheet & Plate | Avg | 280 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Pipe, Tube & Other | Avg | 1020 | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |
| Fume Scrubber$^{(2)}$ | Avg | 15 GPM | 30 | $10^{(1)}$ |
| | Max | | 70 | $30^{(1)}$ |

TABLE I-9
BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Conc. (mg/l) TSS | O&G |
|---|---|---|---|---|
| **Hydrochloric Acid Pickling** | | | | |
| Acid Regeneration | Avg | 100 GPM | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| **Combination Acid Pickling** | | | | |
| Rod, Wire & Coil | Avg | 510 | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| Bar, Billet & Bloom | Avg | 230 | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| Continuous: Strip, Sheet & Plate | Avg | 1500 | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| Batch: Strip, Sheet & Plate | Avg | 460 | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| Pipe, Tube & Other | Avg | 770 | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| Fume Scrubber(2) | Avg | 15 GPM | 30 | 10(1) |
| | Max | | 70 | 30(1) |
| **Cold Forming** | | | | |
| Cold Rolling: Recir.-Single Stand | Avg | 5 | 30 | 10 |
| | Max | | 60 | 25 |
| Cold Rolling: Recir.-Multi Stand | Avg | 25 | 30 | 10 |
| | Max | | 60 | 25 |
| Cold Rolling: Combination | Avg | 300 | 30 | 10 |
| | Max | | 60 | 25 |
| Cold Rolling: Direct Appl.-Single Stand | Avg | 90 | 30 | 10 |
| | Max | | 60 | 25 |
| Cold Rolling: Direct Appl.-Multi Stand | Avg | 400 | 30 | 10 |
| | Max | | 60 | 25 |
| Pipe & Tube | Avg | BPT | | |
| | Max | | | |
| **Alkaline Cleaning** | | | | |
| Batch | Avg | 250 | 30 | 10 |
| | Max | | 70 | 30 |
| Continuous | Avg | 350 | 30 | 10 |
| | Max | | 70 | 30 |
| **Hot Coating-(all coating operations)** | | | | |
| Strip, Sheet & Misc. wo/Scrubbers | Avg | 600 | 30 | 10 |
| | Max | | 70 | 30 |
| Wire & Fasteners wo/Scrubbers | Avg | 2400 | 30 | 10 |
| | Max | | 70 | 30 |
| Fume Scrubbers(2) | Avg | 100 GPM | 30 | 10 |
| | Max | | 70 | 30 |

TABLE I-9
BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

Note: pH is also regulated in all subcategories and is limited to 6.0 to 9.0 standard units.

(1) This pollutant applies only when these wastes are treated in combination with cold rolling mill wastes.
(2) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.

TABLE I-10

BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Limitations (kg/kkg) TSS | O&G |
|---|---|---|---|---|
| Cokemaking | | | | |
| Iron & Steel-Biological | Avg | 225 | 0.131 | 0.0109 |
| | Max | | 0.253 | 0.0327 |
| Iron & Steel-Physical Chemical | Avg | 175 | 0.131 | 0.0109 |
| | Max | | 0.253 | 0.0327 |
| Merchant-Biological | Avg | 240 | 0.140 | 0.0116 |
| | Max | | 0.270 | 0.0348 |
| Merchant-Physical Chemical | Avg | 190 | 0.140 | 0.0116 |
| | Max | | 0.270 | 0.0348 |
| Beehive | Avg | BPT | | |
| | Max | | | |
| Sintering | Avg | Reserved | | |
| | Max | | | |
| Ironmaking | | | | |
| Iron | Avg | Reserved | | |
| | Max | | | |
| Ferromanganese | Avg | Reserved | | |
| | Max | | | |
| Steelmaking | | | | |
| BOF: Semi-wet | Avg | BPT | | |
| | Max | | | |
| BOF: Wet-Open Combustion | Avg | Reserved | | |
| | Max | | | |
| BOF: Wet-Suppressed Combustion | Avg | Reserved | | |
| | Max | | | |
| Open Hearth: Wet | Avg | Reserved | | |
| | Max | | | |
| Electric Arc Furnace: Semi-Wet | Avg | BPT | | |
| | Max | | | |
| Electric Arc Furnace: Wet | Avg | Reserved | | |
| | Max | | | |
| Vacuum Degassing | Avg | Reserved | | |
| | Max | | | |
| Continuous Casting | Avg | Reserved | | |
| | Max | | | |

TABLE I-10
BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Limitations (kg/kkg) TSS | O&G |
|---|---|---|---|---|
| Hot Forming | | | | |
| Primary: Carbon & Spec. w/o Scarfers | Avg | 897 | 0.0561 | - |
| | Max | | 0.150 | 0.0374 |
| Primary: Carbon & Spec. w/Scarfers | Avg | 1326 | 0.0830 | - |
| | Max | | 0.221 | 0.0553 |
| Section: Carbon | Avg | 2142 | 0.134 | - |
| | Max | | 0.357 | 0.0894 |
| Section: Specialty | Avg | 1344 | 0.0841 | - |
| | Max | | 0.224 | 0.0561 |
| Flat: Hot Strip & Sheet (Carbon & Spec.) | Avg | 2560 | 0.160 | - |
| | Max | | 0.427 | 0.107 |
| Flat: Plate-Carbon | Avg | 1360 | 0.0851 | - |
| | Max | | 0.227 | 0.0567 |
| Flat: Plate-Specialty | Avg | 600 | 0.0375 | - |
| | Max | | 0.100 | 0.0250 |
| Pipe & Tube | Avg | 1270 | 0.0795 | - |
| | Max | | 0.212 | 0.0530 |
| Salt Bath Descaling | | | | |
| Oxidizing: Batch, Sheet & Plate | Avg | 700 | 0.0876 | - |
| | Max | | 0.204 | - |
| Oxidizing: Batch, Rod & Wire | Avg | 420 | 0.0526 | - |
| | Max | | 0.123 | - |
| Oxidizing: Batch, Pipe & Tube | Avg | 1700 | 0.213 | - |
| | Max | | 0.496 | - |
| Oxidizing: Continuous | Avg | 330 | 0.0413 | - |
| | Max | | 0.0964 | - |
| Reducing: Batch | Avg | 325 | 0.0407 | - |
| | Max | | 0.0949 | - |
| Reducing: Continuous | Avg | 1820 | 0.228 | - |
| | Max | | 0.532 | - |
| Sulfuric Acid Pickling | | | | |
| Rod, Wire & Coil | Avg | 280 | 0.0350 | 0.0117(1) |
| | Max | | 0.0818 | 0.0350(1) |
| Bar, Billet & Bloom | Avg | 90 | 0.0113 | 0.00375(1) |
| | Max | | 0.0263 | 0.0113(1) |
| Strip, Sheet & Plate | Avg | 180 | 0.0225 | 0.00751(1) |
| | Max | | 0.0526 | 0.0225(1) |
| Pipe, Tube & Other | Avg | 500 | 0.0626 | 0.0209(1) |
| | Max | | 0.146 | 0.0626(1) |

TABLE I-10
BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Limitations (kg/kkg) | |
|---|---|---|---|---|
| | | | TSS | O&G |
| Sulfuric Acid Pickling | | | | |
| Fume Scrubber(2) | Avg | 15 GPM | 2.45 | 0.819(1) |
| | Max | | 5.72 | 2.45(1) |
| Hydrochloric Acid Pickling | | | | |
| Rod Wire & Coil | Avg | 490 | 0.0613 | 0.0204(1) |
| | Max | | 0.143 | 0.0613(1) |
| Strip, Sheet & Plate | Avg | 280 | 0.0350 | 0.0117(1) |
| | | | 0.0818 | 0.0350(1) |
| Pipe, Tube & Other | Avg | 1020 | 0.128 | 0.0426(1) |
| | Max | | 0.298 | 0.128(1) |
| Fume Scrubber(2) | Avg | 15 GPM | 2.45 | 0.0819(1) |
| | Max | | 5.72 | 2.45(1) |
| *Acid Regeneration(2) | Avg | 100 GPM | 16.3 | 5.45(1) |
| | Max | | 38.1 | 16.3(1) |
| Combination Acid Pickling | Avg | 510 | 0.0638 | 0.0213(1) |
| Rod Wire & Coil | Max | | 0.149 | 0.0638(1) |
| Bar, Billet & Bloom | Avg | 230 | 0.0288 | 0.00960(1) |
| | Max | | 0.0672 | 0.0288(1) |
| Continuous-Strip, Sheet & Plate | Avg | 1500 | 0.188 | 0.0626(1) |
| | Max | | 0.438 | 0.188(1) |
| Batch-Strip, Sheet & Plate | Avg | 460 | 0.0576 | 0.0192(1) |
| | Max | | 0.134 | 0.0576(1) |
| Pipe, Tube & Other | Avg | 770 | 0.0964 | 0.0321(1) |
| | Max | | 0.225 | 0.0964(1) |
| Fume Scrubber(2) | Avg | 15 GPM | 2.45 | 0.819(1) |
| | Max | | 5.72 | 2.45(1) |
| Cold Forming | | | | |
| Cold Rolling: Recirc.-Single Stand | Avg | 5 | 0.000626 | 0.000209 |
| | Max | | 0.00125 | 0.000522 |
| Cold Rolling: Recirc.-Multi Stand | Avg | 25 | 0.00313 | 0.00104 |
| | Max | | 0.00626 | 0.00261 |
| Cold Rolling: Combination | Avg | 300 | 0.0375 | 0.0125 |
| | Max | | 0.0751 | 0.0313 |
| Cold Rolling: Direct Appl.-Single Stand | Avg | 90 | 0.0113 | 0.00375 |
| | Max | | 0.0225 | 0.00939 |

TABLE 10
BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

| Subcategory | | Discharge Flow (GPT) | BCT Effluent Limitations (kg/kkg) | |
|---|---|---|---|---|
| | | | TSS | O&G |
| Cold Forming Cont. | | | | |
| Cold Rolling: Direct Appl.-Multi Stand | Avg | 400 | 0.0501 | 0.0167 |
| | Max | | 0.100 | 0.0417 |
| Pipe & Tube | Avg | BPT | | |
| | Max | | | |
| Alkaline Cleaning. | | | | |
| Batch | Avg | 250 | 0.0313 | 0.0104 |
| | Max | | 0.0730 | 0.0313 |
| Continuous | Avg | 350 | 0.0438 | 0.0146 |
| | Max | | 0.102 | 0.0438 |
| Hot Coating-includes all coating operations | | | | |
| Strip, Sheet & Misc. wo/Scrubbers | Avg | 600 | 0.0751 | 0.0250 |
| | Max | | 0.175 | 0.0751 |
| Wire & Fasteners wo/Scrubbers | Avg | 2400 | 0.300 | 0.100 |
| | Max | | 0.701 | 0.300 |
| Fume Scrubbers(2) | Avg | 100 GPM | 16.3 | 5.45 |
| | Max | | 38.1 | 16.3 |

Note: pH is also regulated in all subcategories and is limited to 6.0 to 9.0 standard units.

(1) This load applies only when these wastes are treated in combination with cold rolling mill wastes.

(2) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. Load is expressed in kg/day x $10^{-5}$.

## TABLE I-11

## EFFLUENT LOAD SUMMARY
## DIRECT AND INDIRECT DISCHARGERS

| | | | Effluent Loadings (tons/year) | | |
|---|---|---|---|---|---|
| Subcategory | Treatment Level | Discharge Flow (MGD) | Toxic Organics(1) | Toxic Metals | Other |
| **A. Cokemaking** | **Raw** | 32.5 | 23,200.8 | 128.8 | 67,088 |
| | **BAT/PSES** | 27.5 | 704.8 | 35.0 | 5,974 |
| **B. Sintering** | **Raw** | 99.2 | 78.8 | 317.5 | 960,420 |
| | **BAT/PSES** | 7.7 | 6.0 | 5.1 | 462 |
| **C. Ironmaking** | **Raw** | 864.0 | 19,948.2 | 34,935.5 | 2,546,149 |
| | **BAT/PSES** | 17.2 | 5.4 | 12.0 | 1,260 |
| **D. Steelmaking** | **Raw** | 273.3 | 12.3 | 22,220.4 | 1,231,042 |
| | **BAT/PSES** | 20.5 | 1.2 | 32.5 | 1,300 |
| **E. Vacuum Degassing** | **Raw** | 55.4 | - | 667.0 | 5,488 |
| | **BAT/PSES** | 0.9 | - | 1.3 | 33 |
| **F. Continuous Casting** | **Raw** | 233.2 | - | 575.4 | 30,193 |
| | **BAT/PSES** | 1.1 | - | 2.2 | 45 |
| **G. Hot Forming** | **Raw** | 3,974.4 | - | 52,964.9 | 6,510,673 |
| | **BPT/PSES** | 1,543.2 | - | 123.1 | 19,852 |
| **H. Salt Bath Descaling** | **Raw** | 1.1 | - | 191.2 | 503 |
| | **BPT/PSES** | 1.1 | - | 0.9 | 26 |
| **I. Acid Pickling** | **Raw** | 86.7 | - | 7,438.4 | 358,422 |
| | **BPT/PSES** | 69.1 | - | 56.5 | 2,955 |
| **J. Cold Forming** | **Raw** | 76.5 | 365.0 | 332.0 | 2,792,058 |
| | **BPT/PSES** | 28.3 | 4.3 | 21.7 | 945 |
| **K. Alkaline Cleaning** | **Raw** | 17.5 | 1.2 | 6.7 | 425 |
| | **BPT** | 17.5 | 1.2 | 5.3 | 492 |
| **L. Hot Coating** | **Raw** | 30.4 | - | 2,098.1 | 4,992 |
| | **BAT/PSES** | 23.9 | - | 12.8 | 755 |
| **Totals** | **Raw** | 5,744.2 | 43,606.3 | 121,875.9 | 14,507,453 |
| | **Treated** | 1,758.0 | 722.6 | 308.4 | 34,099 |

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(1) Includes total cyanide and phenolic compounds (4AAP).

TABLE I-12

EFFLUENT LOAD SUMMARY
IRON AND STEEL INDUSTRY - DIRECT DISCHARGES

| Subcategory | Treatment Level | Discharge Flow (MGD) | Effluent Loadings (Tons/Year) | | |
|---|---|---|---|---|---|
| | | | Toxic Organics(1) | Toxic Metals | Others |
| A. Cokemaking | Raw | 25.1 | 17,922.0 | 99.5 | 51,824 |
| | BPT | 33.3 | 416.1 | 35.4 | 8,200 |
| | BAT-1 | 22.7 | 120.3 | 24.2 | 3,042 |
| B. Sintering | Raw | 93.4 | 74.1 | 298.8 | 903,925 |
| | BPT | 7.2 | 5.7 | 14.0 | 844 |
| | BAT-1 | 7.2 | 5.7 | 4.8 | 433 |
| C. Ironmaking | Raw | 825.6 | 19,061.6 | 33,382.8 | 2,432,987 |
| | BPT | 29.2 | 287.8 | 77.1 | 6,548 |
| | BAT-4 | 16.4 | 5.1 | 11.4 | 1,199 |
| D. Steelmaking | Raw | 252.1 | 11.3 | 20,887.2 | 1,138,622 |
| | BPT | 18.9 | 1.1 | 116.0 | 2,250 |
| | BAT-2(2) | 18.9 | 1.1 | 29.7 | 1,202 |
| E. Vacuum Degassing | Raw | 55.4 | - | 667.0 | 5,488 |
| | BPT | 0.9 | - | 8.4 | 55 |
| | BAT-2 | 0.9 | - | 1.3 | 33 |
| F. Continuous Casting | Raw | 199.9 | - | 493.2 | 25,880 |
| | BPT | 4.4 | - | 10.8 | 333 |
| | BAT-2 | 0.9 | - | 1.7 | 35 |
| G. Hot Forming | Raw | 3,679.9 | - | 49,460.4 | 6,052,741 |
| | BPT | 1,418.5 | - | 113.9 | 18,159 |
| | BAT(3) | 1,418.5 | - | 113.9 | 18,159 |
| H. Salt Bath Descaling | Raw | 1.0 | - | 161.2 | 432 |
| | BPT | 1.0 | - | 0.8 | 22 |
| | BAT(3) | 1.0 | - | 0.8 | 22 |
| I. Acid Pickling | Raw | 72.5 | - | 6,384.5 | 306,145 |
| | BPT | 58.4 | - | 48.4 | 2,524 |
| | BAT(3) | 58.4 | - | 48.4 | 2,524 |
| J. Cold Forming | Raw | 73.3 | 356.9 | 320.6 | 2,787,508 |
| | BPT | 28.1 | 4.1 | 21.4 | 939 |
| | BAT(3) | 28.1 | 4.1 | 21.4 | 939 |

TABLE I-12
EFFLUENT LOAD SUMMARY
IRON AND STEEL INDUSTRY - DIRECT DISCHARGES
PAGE 2

| Subcategory | Treatment Level | Discharge Flow (MGD) | Effluent Loadings (Tons/Year) | | |
|---|---|---|---|---|---|
| | | | Toxic Organics (1) | Toxic Metals | Others |
| K. Alkaline Cleaning | Raw | 12.4 | 0.9 | 4.8 | 302 |
| | BPT (4) | 12.4 | 0.9 | 3.4 | 369 |
| | BAT | 12.4 | 0.9 | 3.4 | 369 |
| L. Hot Coating | Raw | 22.9 | - | 1,829.3 | 4,082 |
| | BPT | 22.8 | - | 12.2 | 724 |
| | BAT-1 (5) | 18.3 | - | 9.8 | 580 |
| Totals | Raw | 5,313.5 | 37,426.8 | 113,989.3 | 13,709,936 |
| | BPT | 1,635.1 | 715.7 | 461.8 | 40,967 |
| | BAT | 1,603.7 | 137.2 | 270.8 | 28,537 |

---

(1) Includes total cyanide and phenolic compounds (4AAP).
(2) BPT for semi-wet steelmaking operations.
(3) BAT is being promulgated at a level equal to BPT in this subcategory.
(4) BAT is not being promulgated in this subcategory.
(5) BAT is being promulgated only for those operations with fume scrubbers.

## TABLE I-13

## EFFLUENT LOAD SUMMARY
## IRON AND STEEL INDUSTRY - INDIRECT DISCHARGES

| Subcategory | Treatment Level | Discharge Flow (MGD) | Effluent Loadings (Tons/Year) Toxic Organics(1) | Toxic Metals | Others |
|---|---|---|---|---|---|
| A. Cokemaking | Raw | 7.4 | 5,278.8 | 29.3 | 15,264 |
| | PSES-1 | 4.8 | 584.5 | 10.8 | 2,932 |
| B. Sintering | Raw | 5.8 | 4.7 | 18.7 | 56,495 |
| | PSES-2 | 0.5 | 0.3 | 0.3 | 29 |
| C. Ironmaking | Raw | 38.4 | 886.6 | 1,552.7 | 113,162 |
| | PSES-5 | 0.8 | 0.3 | 0.6 | 61 |
| D. Steelmaking | Raw | 21.2 | 1.0 | 1,333.2 | 92,420 |
| | PSES-3(2) | 1.6 | 0.1 | 2.8 | 98 |
| E. Vacuum Degassing | Raw | * | * | * | * |
| | PSES-3 | * | * | * | * |
| F. Continuous Casting | Raw | 33.3 | - | 82.2 | 4,313 |
| | PSES-3 | 0.2 | - | 0.5 | 10 |
| G. Hot Forming | Raw | 294.5 | - | 3,504.5 | 457,932 |
| | PSES(3) | 124.7 | - | 9.2 | 1,693 |
| H. Salt Bath Descaling | Raw | 0.1 | - | 30.0 | 71 |
| | PSES-1(BPT) | 0.1 | - | 0.1 | 4 |
| I. Acid Pickling | Raw | 14.2 | - | 1,053.9 | 52,277 |
| | PSES-1(BPT) | 10.7 | - | 8.1 | 431 |
| J. Cold Forming | Raw | 3.2 | 8.1 | 11.4 | 4,550 |
| | PSES-1(BPT)(4) | 0.2 | 0.2 | 0.3 | 6 |
| K. Alkaline Cleaning | Raw | 5.1 | 0.3 | 1.9 | 123 |
| | PSES(3) | 5.1 | 0.3 | 1.9 | 123 |
| L. Hot Coating | Raw | 7.5 | - | 268.8 | 910 |
| | PSES-2(5) | 5.6 | - | 3.0 | 175 |
| Total | Raw | 430.7 | 6,179.5 | 7,886.6 | 797,517 |
| | PSES | 154.3 | 585.4 | 37.6 | 5,562 |

---

*There are no indirect dischargers in this subcategory.

(1) Includes total cyanide and phenolic compounds (4AAP).

(2) PSES-1 for semi-wet steelmaking operations.

(3) Only general pretreatment standards are being promulgated in this subcategory.

(4) Only general pretreatment standards are being promulgated for cold worked pipe and tube operations using water.

(5) PSES-1 for those operations without fume scrubbers.

TABLE I-14

COST SUMMARY
IRON AND STEEL INDUSTRY
COSTS (MILLIONS OF 7/1/78 DOLLARS)

| | BPT | | | | BAT | | | | PSES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Capital | | Annual | | Capital | | Annual | | Capital | | Annual | |
| Subcategory | In-Place | Required | In-Place | Required | In-Place | Required | In-Place | Required | In-Place | Required | In-Place | Required |
| A. Cokemaking | 121.72 | 47.65 | 30.80 | 10.93 | 11.12 | 32.95 | 3.59 | 7.90 | 30.87 | 14.93 | 7.60 | 2.57 |
| B. Sintering | 58.82 | 5.07 | 12.10 | 1.34 | 0.51 | 5.51 | 0.05 | 0.74 | 3.23 | 0.36 | 0.78 | 0.05 |
| C. Ironmaking | 412.34 | 22.40 | 52.53 | 2.74 | 7.63 | 23.20 | 2.27 | 6.77 | 13.21 | 0.65 | 2.26 | 0.18 |
| D. Steelmaking | 108.76 | 3.25 | 24.63 | 0.61 | 2.55 | 8.19 | 0.35 | 1.24 | 11.69 | 0.00 | 2.67 | 0.00 |
| E. Vacuum Degassing | 20.43 | 7.47 | 2.99 | 1.11 | 0.20 | 2.82 | 0.03 | 0.39 | - | - | - | - |
| F. Continuous Casting | 59.55 | 4.84 | 8.62 | 0.76 | 0.82 | 2.23 | 0.11 | 0.31 | 9.01 | 0.34 | 1.34 | 0.05 |
| G. Hot Forming | 366.26 | 94.03 | -40.99 | 11.98 | - | - | - | - | 29.12 | 3.39 | -1.58 | 0.27 |
| H. Salt Bath Descaling | 4.54 | 0.38 | 0.67 | 0.05 | - | - | - | - | 0.20 | 1.00 | 0.03 | 0.15 |
| I. Acid Pickling | 144.65 | 5.38 | 51.16 | 3.05 | - | - | - | - | 11.03 | 13.86 | 5.09 | 4.17 |
| J. Cold Forming | 28.98 | 5.87 | 3.62 | 0.95 | - | - | - | - | 0.09 | 0.06 | 0.01 | 0.00 |
| K. Alkaline Cleaning | 11.68 | 0.58 | 1.60 | 0.08 | - | - | - | - | 0.47 | 0.00 | 0.06 | 0.00 |
| L. Hot Coating | 29.83 | 4.60 | 4.31 | 0.76 | 0.45 | 0.51 | 0.05 | 0.06 | 2.65 | 2.30 | 0.38 | 0.33 |
| Total | 1,367.56 | 201.52 | 152.04 | 34.36 | 23.28 | 75.41 | 6.45 | 17.41 | 111.57 | 36.89 | 18.64 | 7.77 |
| Confidential Plants | 39.83 | 4.44 | 4.98 | 0.91 | 0.80 | 1.94 | 0.18 | 0.43 | 2.14 | 4.02 | 0.70 | 0.85 |
| Costs for Components Installed Beyond Treatment Requirements | 84.10 | 0.00 | 11.71 | 0.00 | - | - | - | - | 18.27 | 0.00 | 2.75 | 0.00 |
| Industry Total | 1,491.49 | 205.96 | 168.73 | 35.27 | 24.08 | 77.35 | 6.63 | 17.84 | 131.98 | 40.91 | 22.09 | 8.62 |

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Basis: Facilities in-place as of 7/1/81.

# TABLE I-15
## CONTROL AND TREATMENT TECHNOLOGY SUMMARY
## IRON AND STEEL INDUSTRY

| SUBCATEGORY/SUBDIVISION | DIRECT DISCHARGERS | | | | | | | | | | | | | | | | | | | | | | | POTW DISCHARGERS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PROCESS | BPT | | | | | | | | | | | BAT | | | | | | | BCT | | NSPS | | PSES | | PSNS | |
| | | EQUALIZATION | GF/OS | AERATION | NEUT. W/ACID | LIME ADDITION | POLYMER ADDITION | SEDIMENTATION | VACUUM FILTER | RECYCLE (%) | COOLING TOWER | OTHER | ALT. No. | EQUAL TO BPT | LIME ADDITION | PRESSURE FILTER | COOLING TOWER | RECYCLE (%) | OTHER | EQUAL TO BPT | RESERVED | EQUAL TO BPT | BPT PLUS: | EQUAL TO BPT | BPT PLUS: | EQUAL TO BPT | BPT PLUS: |
| A. COKEMAKING | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Biological | ASF,DP,CT(1) | ● | ● | ● | ● | ● | | CL | ● | | | ASL, BOA | 1 | | | | ●(2) | 96(3) | BOA, C&C | ● | | | BAT | (4) | | (4) | |
| Physical Chemical | ASF,DP,CT(1) | ● | ● | | ● | ● | | | | | | ASL | 1 | | | ● | | 96(3) | ACG | ● | | | | | | | |
| B. SINTERING | | | | | ● | | ● | T | ● | 92 | | | 1 | | | ● | | | | | ● | | BAT | | BAT | | BAT |
| C. IRONMAKING | | | | | | | ● | T | ● | 96 | ● | | 4 | | ● | | | 98 | TP,CLB SDA | | ● | | BAT, FP | | BAT | | BAT |
| D. STEELMAKING | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Semi-Wet | | | | | | | ● | DT | | 100 | | | – | ● | | | | | | ● | | ● | | ● | | ● | |
| Wet | | | | | ● | ● | ● | T | ● | 90-95 | | | 2 | | ● | | | | TP | | ● | | BAT | | BAT | | BAT |
| E. VACUUM DEGASSING | | | | | | | | PSP | | 98 | ● | | 2 | | ● | | | | TP, NA | | ● | | BAT | | BAT | | BAT |
| F. CONTINUOUS CASTING | | | | | | | | DT | | 96 | ● | FF, SS | 2 | | ● | | | 99 | TP, NA | | ● | | BAT(5) | | BAT | | BAT(5) |
| G. HOT FORMING | | | | | | | | PSP/ CLR | ● | 58-77 | | FP, SS | - | ● | | | | | | ● | | | CT RTP (96) | (6) | | (6) | |
| H. SALT BATH DESCALING | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oxidizing | | ● | | | ● | ● | ● | CL | ● | | | SDA | - | ● | | | | | | ● | | | FP | ● | | | FP |
| Reducing | | ● | | | | | ● | CL | ● | | | CLB | - | ● | | | | | | ● | | | FP | ● | | | FP |
| I. ACID PICKLING | | ● | | ● | | ● | ● | CL | ● | 89(7) | | SS | - | ● | | | | | | ● | | | RR | ● | | | RR |
| J. COLD FORMING | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cold Rolling | RTP | ● | ● | | | ● | ● | | ● | | | | - | ● | | | | | | ● | | ● | | ● | | ● | |
| CF-Pipe & Tube | | | | | | | | PSP | | 100 | | SS | - | ● | | | | | | ● | | ● | | ● | | ● | |
| K. ALKALINE CLEANING | | ● | | | ● | | ● | CL | ● | | | SS | - | ● | | | | | | ● | | ● | | (6) | | (6) | |
| H. HOT COATING | | ● | | | ● | ● | ● | CL | ● | | | SDA(8) | 1 | | | | | 85(7) | | ● | | | BAT, RR | | BAT | | BAT, RR |

NOTES:

● - Designates a component contained in the treatment model for the particular subcategory.

(1) Cooling towers on final cooler wastewaters.

(2) Indirect heat exchanger installed at biological reactor to optimize temperature.

(3) Applies to barometric condenser on crystallizer only.

(4) BPT without BOA, vacuum filter, and aeration. Includes recycle on barometric condenser.

(5) Based upon pressure filters prior to recycle step.

(6) No specific pretreatment standards. Only general pretreatment standards apply.

(7) Recycle of fume scrubber water.

(8) Only for those coating operations which discharge wastewaters from a chromate rinse step.

KEY TO ABBREVIATIONS

ACG- Granular Carbon Adsorption
ASF- Free Ammonia Still
ASL- Fixed Ammonia Still
BOA- Biological Oxidation
C & C- Caustic and Carbonate Add.
CL- Clarifier
CLB- Breakpoint Chlorination
CLR- Roughing Clarifier

CT- Cooling Tower
DP- Dephenolizer
DT- Drag Tank
E- Equalization
FF- Flatbed Filter
FP- Pressure Filter
GF- Gas Flotation
OS- Oil Separator

PSP- Primary Scale Pit
RR- Rinse Reduction
RTP- Recycle Treated Process
RTP(96)- 96% Recycle
SDA- Sulfur Dioxide Add.
SS- Surface Skimmer
T- Thickener
TP- Tube Plate Settler

# VOLUME I

# SECTION II

# INTRODUCTION

## I. Legal Authority

The regulation which this Development Document supports has been promulgated by the Agency under authority of Sections 301, 304, 306, 307 and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C §§ 1251 et seq., as amended by the Clean Water Act of 1977, P.L. 95-217)(the "Act"). This regulation has also been promulgated in response to the "Settlement Agreement" in Natural Resources Defense Council, Inc., et al. v Train, 8 ERC 2120 (D.D.C. 1976), modified, 12 ERC 1833 (D.D.C. 1979).

## II. Background

### A. The Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," Section 101(a). By July 1, 1977, existing industrial dischargers were required to achieve "effluent limitations requiring the application of the best practicable control technology currently available" (BPT), Section 301(b)(1)(A); and, by July 1, 1983, these dischargers were required to achieve "effluent limitations requiring the application of the best available technology economically achievable...which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants" (BAT), Section 301(b)(2)(A). New industrial direct dischargers were required to comply with Section 306 new source performance standards (NSPS) based upon best available demonstrated technology; and new and existing dischargers to publicly owned treatment works (POTWs) were subject to pretreatment standards under Sections 307(b) and (c) of the Act. While the requirements for direct dischargers were to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the Act, pretreatment standards were made enforceable directly against dischargers to POTWs (indirect dischargers).

Although Section 402(a)(1) of the 1972 Act authorized the setting of requirements for direct dischargers on a case-by-case basis, Congress intended that, for the most part, control requirements would be based upon regulations promulgated by the Administrator of EPA. Section 304(b) of the Act required the Administrator to promulgate regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of BPT and BAT. Moreover, Sections 304(c) and 306 of the Act required promulgation of regulations for NSPS, and Sections 304(f), 307(b), and 307(c) required promulgation of regulations for pretreatment standards. In addition to these regulations for designated industry categories, Section 307(a) of the Act required the Administrator to promulgate effluent standards applicable to all dischargers of toxic pollutants. Finally, Section 501(a) of the Act authorized the Administrator to prescribe any additional regulations "necessary to carry out his functions" under the Act.

The Agency was unable to promulgate many of these regulations by the dates contained in the Act. In 1976, the Agency was sued by several environmental groups, and in settlement of this lawsuit, the Agency and the plaintiffs executed a "Settlement Agreement" which was approved by the Court. This Agreement required the Agency to develop a program and adhere to a schedule for promulgating BAT effluent limitations guidelines, pretreatment standards, and new source performance standards for 65 "priority" pollutants and classes of pollutants for 21 major industries. See Natural Resources Defense Council, Inc. v. Train, 8 ERC 2120 (D.D.C. 1976), as modified 12 ERC 1833 (D.D.C. 1979).

On December 27, 1977, the President signed into law the Clean Water Act of 1977. This law makes several important changes in the Federal water pollution control program including several of the basic elements of the Settlement Agreement program for toxic pollution control. Sections 301(b)(2)(A) and 301(b)(2)(C) of the Act now require the achievement by July 1, 1984 of effluent limitations requiring application of BAT for "toxic" pollutants, including the 65 "priority" pollutants and classes of pollutants which Congress declared "toxic" under Section 307(a) of the Act. Likewise, the Agency's programs for new source performance standards and pretreatment standards are now aimed principally at toxic pollutant controls. Moreover, to strengthen the toxics control program, Section 304(e) of the Act authorizes the Administrator to prescribe "best management practices" (BMPs) to prevent the release of toxic and hazardous pollutants from plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage associated with, or ancillary to, the manufacturing or treatment process.

In keeping with its emphasis on toxic pollutants, the Clean Water Act of 1977 also revises the control program for nontoxic pollutants. Instead of BAT for "conventional" pollutants identified under Section 304(a)(4) (including biochemical oxygen demand, oil and grease, suspended solids, fecal coliform and pH), the new Section 301(b)(2)(E) requires achievement by July 1, 1984, of "effluent limitations requiring the application of the best conventional pollutant control technology" (BCT). The factors considered in assessing BCT for an industry include the costs of attaining a reduction in effluents and the effluent reduction benefits derived compared to the costs and effluent reduction benefits from the discharge of publicly owned treatment works (Section 304(b)(4)(B)). For nontoxic, nonconventional pollutants, Sections 301(b)(2)(A) and (b)(2)(F) require achievement of BAT effluent limitations within three years after their establishment or July 1, 1984, whichever is later, but not later than July 1, 1987.

This regulation includes effluent limitations for BPT, BAT and BCT, performance standards for new sources (NSPS), and pretreatment standards for new and existing sources (PSNS and PSES) which were promulgated under Sections 301,304,306,307 and 501 of the Clean Water Act.

## B. Prior EPA Regulations

On June 28, 1974, EPA promulgated effluent limitations for BPT and BAT, new source performance standards, and pretreatment standards for new sources for basic steelmaking operations (Phase I) of the integrated steel industry, 39 FR 24114-24133, 40 CFR Part 420, Subparts A-L. That regulation covered 12 subcategories of the industry: By-Product Cokemaking, Beehive Cokemaking, Sintering, Blast Furnace (Iron), Blast Furnace (Ferromanganese), Basic Oxygen Furnace (Semi-Wet Air Pollution Control Methods), Basic Oxygen Furnace (Wet Air Pollution Control Methods), Open Hearth, Electric Arc Furnace (Semi-Wet Air Pollution Control Methods), Electric Arc Furnace (Wet Air Pollution Control Methods), Vacuum Degassing, and Continuous Casting and Pressure Slab Molding.

In response to several petitions for review, the United States Court of Appeals for the Third Circuit remanded that regulation on November 7, 1975, American Iron and Steel Institute, et al. v EPA, 526 F.2d 1027 (3rd Cir. 1975). While the Court rejected all technical challenges to the BPT limitations, it held that the BAT effluent limitations and NSPS for certain subcategories were "not demonstrated." In addition, the court questioned the entire regulation on the grounds that EPA had failed to consider adequately the impact of plant age on the cost or feasibility of retrofitting pollution controls, had failed to assess the impact of the regulations on water scarcity in arid and semi-arid regions of the country, and had failed to make adequate "net/gross" provisions for pollutants found in intake water supplies.[1]

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[1] The court also held that the "form" of the regulations was improper, because they did not provide "ranges" of limitations to be selected by permit issuers. This holding, however, was recalled in American Iron and Steel Institute, et al. v EPA, (3d Cir.1977).

On March 29, 1976, EPA promulgated BPT effluent limitations and proposed BAT limitations, NSPS standards and PSNS standards for steel forming and finishing operations (Phase II) within the steel industry, 39 FR 12990-13030, 40 CFR Part 420, Subparts M-Z. That regulation covered 14 subcategories of the industry: Hot Forming- Primary; Hot Forming-Section; Hot Forming-Flat; Pipe & Tube; Pickling-Sulfuric Acid-Batch & Continuous; Pickling-Hydrochloric Acid-Batch & Continuous; Cold Rolling; Hot Coating-Galvanizing; Hot Coatings-Terne; Miscellaneous Runoffs-Storage Piles, Casting, and Slagging; Combination Acid Pickling-Batch and Continuous; Scale Removal-Kolene and Hydride; Wire Pickling and Coating, and Continuous Alkaline Cleaning.

The U.S. Court of Appeals for the Third Circuit remanded that regulation on September 14, 1977, American Iron and Steel Institute, et al. v EPA, 568 F.2d 284 (3d Cir. 1977). While the court again rejected all technical challenges to the BPT limitations, it again questioned the regulation in regard to the age/retrofit and water scarcity issues. In addition, the court invalidated the regulation for lack of proper notice to the specialty steel industry, and directed EPA to reevaluate its cost estimates in light of "site-specific costs" and to reexamine its economic impact analysis.[2]

On January 28, 1981 the Agency promulgated General Pretreatment Regulations applicable to existing and new indirect dischargers within the steel industry and other major industries, 46 FR 9404 et seq, 40 CFR Part 403. See also 47 FR 4518 (February 1, 1982).

## C. Overview of the Industry

The manufacture of steel involves many processes which require large quantities of raw materials and other resources. Steel facilities range from comparatively small plants engaging in one or more production processes to extremely large integrated complexes engaging in several or all production processes. Even the smallest steel plant, however, represents a fairly large industrial facility. Because of the wide variety of products and processes, operations vary from plant to plant. Table II-1 lists the various products classified by the Bureau of the Census under Major Group 33 - Primary Metal Industries.

The steel industry can be segregated into two major components - raw steelmaking and forming and finishing operations. The Agency estimates that there are about 680 plant locations containing over 2000 individual steelmaking and forming and finishing operations. A listing of these plants is presented in Appendix

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[2] The court also held that the Agency had no statutory authority to exempt plants in the Mahoning Valley region of Eastern Ohio from compliance with the BPT limitations.

B. Table II-2 is an inventory of production operations by subcategory.

In the first major process, coal is converted to coke which is then combined with iron ore and limestone in blast furnaces to produce iron. The iron is then converted into steel in either open hearth, basic oxygen, or electric arc furnaces. Finally, the steel can be further refined by vacuum degassing. Following these steelmaking operations, the steel is subjected to a variety of hot and cold forming and finishing operations. These operations produce products of various shapes and sizes, and impart desired mechanical and surface characteristics. Figure II-1 is a process flow diagram of the steelmaking segment of the industry.

Coke plants are operated at integrated facilities to supply coke for the production of iron in blast furnaces or as stand alone facilities to supply coke to other users. Nearly all active coke plants are by-product plants which produce, in addition to coke, such usable by-products as coke oven gas, coal tar, crude or refined light oils, ammonium sulfate or anhydrous ammonia, and naphthalene. A by-product coke plant consists of ovens in which bituminous coal is heated in the absence of air to drive off volatile components. The coke is supplied to blast furnaces, while the volatile components are recovered and processed into materials of potential value. Less than one percent of domestic coke is produced in beehive cokemaking processes.

The coke from by-product cokemaking and beehive cokemaking is then supplied to blast furnace processes where molten iron is produced for subsequent steelmaking. In blast furnaces, iron ore, limestone and coke are placed into the top of the furnace and heated air is blown into the bottom. Combustion of the coke provides heat and a reducing atmosphere which produce metallurgical reactions in the furnace. The limestone forms a fluid slag which combines with unwanted impurities in the ore. Two kkg (2.2 tons) of ore, 0.54 kkg (0.6 tons) of coke, 0.45 kkg (0.5 tons) of limestone, and 3.2 kkg (3.5 tons) of air produce approximately 0.9 kkg (1 ton) of iron, 0.45 kkg (0.5 tons) of slag, and 4.5 kkg (5 tons) of blast furnace gas containing the fines (flue dust) carried out by the blast. Molten iron and molten slag, which floats on top of the iron, are periodically withdrawn from the bottom of the furnace. Blast furnace flue gas, which has heating value, is cleaned and then burned in stoves to preheat the incoming air to the furnace.

Steel is an alloy of iron containing less than 1.0% carbon. The basic raw materials for steelmaking are hot metal, pig iron, or steel scrap, limestone, burned lime, dolomite, fluorspar, iron ores, and iron-bearing materials such as pellets or mill scale. In steelmaking operations, the furnace charge is melted and refined by oxidizing certain constituents, particularly carbon in the molten bath, to specified low levels. Various alloying elements are added to produce different grades of steel.

The principal steelmaking processes in use today are the Basic Oxygen Furnace (BOF or BOP), the Open Hearth Furnace, and the Electric Arc Furnace. These processes refine the product of the blast furnace (hot metal or, if cooled, pig iron) which contains approximately 6% carbon. About fifteen percent of the steel produced in this country is made in open hearth furnaces. However, the trend has been towards less steel production in open hearth furnaces because of inefficiencies in the process compared to BOF and electric furnace steelmaking. Open hearth furnaces are similar in design, but may vary widely in capacity. Furnaces in this country range in capacity from 9 to 545 kkg (10 to 600 tons) per heat. The steelmaking ingredients are charged into the front of the furnace through movable doors; while the flame to refine the steel is supplied by liquid or gaseous fuel ignited by hot air.

In the standard open hearth furnace, molten steel is tapped from the furnace eight to ten hours after the first charge. Many furnaces use oxygen lances which create more intense heat to reduce tap-to-tap time. The tap-to-tap time for the oxygen-lanced open hearth averages about eight hours. The average is about ten hours when oxygen is not used. The open hearth furnace allows the operator, in effect, to "cook" the steel to required specifications. The nature of the furnace permits the operator to continually sample the contents and make necessary additions. The major drawback of the process is the long time required to produce a "heat."

Since the introduction in the United States of the more productive basic oxygen process, open hearth production has declined from a peak of 93 million kkg (102 million tons) in 1956 to 19 million kkg (21 million tons) in 1978. Most basic oxygen furnaces can produce eight times the amount of steel produced by a comparable open hearth furnace during the same production time. The annual domestic production of steel by the basic oxygen process has increased from about 545,000 kkg (600,000 tons) in 1957 to 75 million kkg (83 million tons) in 1978.

Vessels for the basic oxygen process generally are vertical cylinders surmounted by a truncated cone. Scrap and molten iron are placed in the vessel and oxygen is then admitted. High-purity oxygen is supplied at high pressure through a water-cooled tube mounted above the center of the vessel. A violent reaction occurs immediately, bringing the molten metal and hot gases into intimate contact causing impurities to burn off quickly. An oxygen blow of 18 to 22 minutes is usually sufficient to refine the metal. Finally, alloys are added and the steel is then tapped. A basic oxygen furnace can produce 180 to 270 kkg (200 to 300 tons) of steel per hour and permits very close control of steel quality. Another major advantage of the process is the ability to process a wide range of raw materials. Scrap may be light or heavy, and the oxide charge may be iron ore, sinter, pellets, or mill scale.

The third process for making steel is the electric arc furnace. This process is uniquely adapted to the production of high quality steels and practically all stainless steel is produced in electric arc furnaces. Electric furnaces range up to nine meters (30 feet) in diameter and produce from 1.8 to 365 kkg (2 to 400 tons) per cycle in 1.5 to 5 hours.

The cycle in electric furnace steelmaking consists of a scrap charge, meltdown, a hot metal charge, a molten metal period, boil, a refining period, and the pour. The electric arc furnace generates heat by passing an electric current between electrodes through the charge in the furnace. The refining process is similar to that of the open hearth furnace, but more precise control is possible in the electric furnace. Use of oxygen in the electric furnace steelmaking process has been common practice for many years.

At many plants, only electric furnaces are operated with scrap as the raw material. In most "cold shops" the electric arc furnace is the sole steelmaking process. They are the principal steelmaking process employed by the so-called mini steel plants which have been built since World War II. The annual production of steel in electric arc furnace has increased from about 7.2 million kkg (8 million tons) in 1957 to 29 million kkg (32 million tons) in 1978. Although electric arc furnaces are usually smaller in capacity than open hearth or basic oxygen furnaces, the trend is toward furnaces with larger heating capacities.

The hot forming (including continuous casting) and cold finishing operations follow the basic steelmaking operations. These operations are so varied that simple classification and description is difficult. In general, hot forming primary mills reduce ingots to slabs or blooms and secondary hot forming mills reduce slabs or blooms to billets, plates, shapes, strip, and other forms. Continuous casting of molten steel into semi-finished shapes is used to bypass the primary hot forming operations. Steel finishing operations involve a number of other processes that are not used to substantially alter the dimensions of the hot rolled product, but are used to impart desirable surface or mechanical properties. The product flow of these operations is illustrated in Figures II-2 and II-3.

It is possible, and often economical, to roll ingots directly through the bloom, slab, or billet stages into more refined or finished steel products in one continuous mill, frequently without reheating. Large tonnages of standard rails, beams, and plates are produced by this practice. Most of the ingot tonnage, however, is rolled into bloom, slabs, or billets in one mill, then cooled, stored, and eventually reheated and rolled in other mills or forged.

The basic operation in a primary mill is the gradual compression of the steel ingot between two rotating rolls. Multiple passes through the rolls, ususally in a reversing mill, are required to reshape the ingot into a slab, bloom, or billet. As the ingot begins to pass through the rolls, high pressure water jets remove surface scale. The ingot is passed back and forth between the horizontal and vertical rolls while manipulators turn the ingot. When the desired shape is achieved in the rolling operation, the end pieces (or crops) are removed by electric or hydraulic shears. The semi-finished pieces are stored or sent to reheating furnaces for subsequent rolling operations.

As the demand for higher quality steel increases, the conditioning of semi-finished products has become more important. This conditioning involves the removal of surface defects from blooms, billets, and slabs prior to shaping. Defects such as rolled seams, light scabs, and checks generally retain their identity during subsequent forming processes and result in inferior products. Surface defects may be removed by manual chipping, machine chipping, scarfing, grinding, milling, and hot steel scarfing. The various mechanical means of surface preparation are common in all metal working and machine shop operations. Scarfing is a process of supplying jet streams of oxygen to the surface of the steel product, while maintaining high surface temperatures, resulting in rapid oxidation and localized melting of a thin layer of the metal. While the process may be manual (consisting of the continuous motion of an oxyacetylene torch along the length of the piece undergoing treatment), in recent years the hot scarfing machine has come into wide use. This machine is designed to remove a thin layer (1/8 in. or less) of metal from the steel passed through the machine in a manner analogous to the motion through rolling mills.

Merchant-bar, rod, and wire mills are continuous operations which produce a wide variety of products, ranging from shapes of small size through bars and rods. The designations of the various mills as well as the classification of their products are not very well defined within industry. In general, the small cross-sectional area and long lengths distinguish the products of these mills. The raw materials for these mills are reheated billets. Some older mills include hand looping operations in which the material is manually passed from mill stand to mill stand. Newer mills include mechanical methods for material transfer. As with other rolling operations, the billet is progressively compressed and shaped to the desired dimensions in a series of rolls. Water sprays are used throughout the operation to remove scale.

The continuous hot strip mill is used to process slabs which are brought to rolling temperatures in continuous reheating furnaces. The slabs then are passed through scale breakers and high pressure water sprays which dislodge loosened scale. A series of roughing stands and a rotary crop shear are used to produce a section that can be finished into a coil of the proper weight and gauge. A second scale breaker and high pressure water sprays precede the finishing stands where final size reductions are made. Cooling water is applied by sprays on the runout table, and the finished strip is coiled. On hot strip mills a six inch thick slab of steel can be formed into a thin strip or sheet a quarter of a mile long in three minutes or less. Strip up to ninty six inches in width can be produced with hot strip mills, although the most common width in newer mills is 80 in. Products of the hot strip mill are sold as produced, or are further processed in cold reduction mills. Cold rolled products are sold as produced or are used in producing plated or coated products.

Welded tubular products are made from hot-rolled skelp with square or slightly beveled edges. The width and thickness of the skelp are selected to suit the desired size and wall thicknesses. The coiled skelp is uncoiled, heated, and fed through forming and welding rolls where the edges are pressed together at high temperatures to form a weld. Welded pipe or tube can also be made by the electric weld processes, where the weld is made by either fusion or resistance welding. Seamless tubular products are made by rotary piercing of a solid round bar or billet, followed by various forming operations to produce the required size and wall thickness.

Correct surface preparation is the most important requirement for satisfactory application of protective and decorative coatings to steel. Without a properly cleaned surface, even the most expensive coatings will fail to adhere or prevent rusting of the steel base. A variety of cleaning methods are used to insure proper surface preparation for subsequent coating. The steel surface must also be cleaned at various production stages to insure that the oxides which form on the surface are not worked into the finished product causing marring, staining, or other surface imperfections.

The pickling process chemically removes oxides and scale from the surface of the steel by the action of water solutions of inorganic acids. While pickling is only one of several methods of removing undesirable surface oxides, this method is most widely used because of comparatively low operating costs and ease of operation.

Some products such as tubes and wire are pickled in batch operations. The product is immersed in an acid solution until the scale or oxide film is removed. The material is lifted from the bath, allowed to drain, and then rinsed by sequential immersion in rinse tanks.

Pickling lines for hot-rolled strip operate continuously on coils that are welded together. The steel passes through the pickler countercurrent to the flow of the acid solution, and is then sheared and recoiled. Most carbon steel is pickled with sulfuric or hydrochloric acid; stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids. Various organic chemicals are used in the pickling process to inhibit acid attack on the base metal, while permitting preferential attack on the oxides. Wetting agents are used to improve the effective contact of the acid solution with the metal surface. As in the batch operation, the steel passes from the pickling bath through a series of rinse tanks.

Alkaline cleaners are used, where necesssary, to remove mineral and animal fats and oils from the steel surface. Caustic soda, soda ash, alkaline silicates, and phosphates are common alkaline cleaning agents. Merely dipping the steel in alkaline solutions of various compositions, concentrations, and temperatures is often satisfactory. The use of electrolytic cleaning may be employed for large scale production, or where a cleaner product is desired. Sometimes the addition of wetting agents to the cleaning bath facilitates cleaning.

Blast cleaning is a process which uses abrasives such as sand, steel, iron grit, or shot to clean the steel. The abrasives come into contact with the steel by either a compressed air blast cleaning apparatus or by rotary type blasting cleaning machines. However, these methods usually result in a roughened surface. The degree of roughness must be regulated to insure that the product is satisfactory for its intended use. Newer methods of blast cleaning produce smooth finishes and, consequently, have potential as substitutes for some types of pickling.

Steel finishing also includes operations such as cold rolling, cold reduction, cold drawing, tin plating, galvanizing, coating with other metals, coating with organic as well as inorganic compounds, and tempering.

Cold reduced flat rolled products are made by cold rolling pickled strip steel. The thickness of the steel is reduced by 25% to 99% in this operation to produce a smooth, dense surface. The product may be sold as cold reduced, but is usually heat treated.

The cold reduction process generates heat that is dissipated by flooded lubrication systems. These systems use palm oil or synthetic oils which are emulsified in water and directed in jets against the rolls and the steel surface during rolling. The cold reduced strip is then cleaned with alkaline detergent solutions to remove the rolling oils prior to coating operations.

Tin plate is made from cleaned and pickled cold reduced strip by either the electrolytic or hot dip process. The hot dip process consists of passing the steel through a light pickling solution; a tin pot containing a flux and the molten tin; and a bath of palm oil. Effluent limitations for discharges from the electrolytic processes are not included in this regulation but are addressed in the Development Document for the Electroplating Point Source Category (40 CFR 413).

Hot dipped galvanized sheets are produced on either batch or continuous lines. The process consists of a light pickling in hydrochloric acid and the application of the zinc coating by dipping in a pot containing molten zinc. Variations in continuous hot dip operations include alkaline cleaning, continuous annealing in controlled atmosphere furnaces, and a variety of fluxing techniques.

In recent years, steel products which are coated with various synthetic resins have become commercially important. Other steel products are being produced with coatings of various metals and inorganic materials. Several major tin plate manufacturers are substituting chromium plating for tin plating for container products. Finishing operations for stainless steel products requiring a bright finish include rolling on temper mills or mechanical polishing.

A more detailed description of steel industry operations can be found in the individual subcategory reports of this Development Document, and in the references cited in Section XIV.

## D. Summary of EPA Guidelines Development Methodology and Overview

### Approach to the Study

In order to develop the effluent limitations and standards, the Agency first studied the steel industry to determine whether differences in raw materials, final products, manufacturing processes, equipment, age and size of plants, water usage, wastewater constituents, or other factors justified the development of separate effluent limitations and standards for different segments of the industry. This study included the identification of untreated wastewater and treated effluent characteristics including: (1) the sources and volume of water used, the processes employed, and the sources of pollutants and wastewaters in the plant, and (2) the constituents of wastewaters, including toxic pollutants. The Agency then identified the wastewater pollutants which were considered for effluent limitations and standards.

Next, the Agency identified several distinct control and treatment technologies, including both in-plant and end-of-process technologies, which are in use or capable of being used in the steel industry. The Agency compiled and analyzed historical data and recently obtained effluent quality data resulting from the application of these technologies. Long term performance, operating limitations, and the reliability of each control and treatment technology were also identified. In addition, the Agency considered the non-water quality environmental impacts of those technologies, including impacts on air quality, solid waste generation, water consumption, and energy requirements.

The Agency then developed the costs of each control and treatment technology by using standard engineering cost analyses as applied to steel industry wastewaters. Unit process costs were derived from model plant characteristics (production, flow and pollutant loads) applied to each treatment process unit (e.g., primary coagulation-sedimentation, activated sludge, multi-media filtration). These unit process costs were added to yield total costs of the model treatment facility developed for each treatment level. After confirming the reasonableness of this methodology by comparing EPA cost estimates to actual treatment system costs supplied by the industry and other data, the Agency evaluated the economic impacts of these costs. Costs are discussed in detail in each subcategory report and the economic impact on the industry is reviewed in the economic impact analysis done for this study.

Upon consideration of these factors, as more fully described below, the Agency identified various control and treatment technologies as models for the BPT, BCT, and BAT limitations and for the PSES, PSNS, and NSPS. The regulation Does not require the installation of any particular technology. Rather, it requires the achievement of effluent limitations and standards representative of the proper operation of the model technologies, equivalent technologies, or operating practices.

Nearly all of the BPT, BCT and BAT limitations and the PSES, PSNS, and NSPS are expressed as mass limits (kg/kkg of product) and were calculated by multiplying three values: (1) effluent concentrations determined from analysis of control technology performance data, (2) model wastewater flow (gal/ton) for each subcategory, and (3) an appropriate conversion factor. The effluent limitations and standards for scrubbers used at acid pickling and hot coating operations are established on the basis of mass load per day (kg/day), and were calculated by multiplying the same three factors, except that the model flows are expressed in gal/minute. The Agency performed the basic calculation for each limited pollutant for each subcategory of the industry.

## Data and Information Gathering Program

Upon initiating this study, the Agency reviewed the data underlying its previous studies of the steel industry.[3] The Agency concluded that additional data were required to respond to the Third Circuit's remands and to develop limitations and standards in accordance with the Settlement Agreement and the Clean Water Act of 1977.

The Agency sent Data Collection Portfolios (DCPs) to owners or operators of all basic steelmaking operations and operators of at least 85% of the steel forming and finishing operations. The DCPs requested information concerning production processes, production capacity and rates, process water usage, wastewater generation rates, wastewater treatment and disposal methods, treatment costs, location, age of production and treatment facilities, as well as general analytical information. The Agency received responses from 391 steelmaking operations and from 1632 steel forming and finishing operations.

The Agency also sent Detailed Data Collection Portfolios (D-DCPs), under the authority of Section 308 of the Act, to owners or operators of 50 basic steelmaking facilities and 128 forming and finishing facilities. The D-DCPs requested detailed information concerning the cost of installing water pollution control equipment including capital, annual, and retrofit costs. The D-DCPs also requested long-term effluent monitoring data and data regarding specific production operations.

The Agency determined the presence and magnitude of the 129 specific toxic pollutants in steel industry wastewaters in a two-part sampling and analysis program that included 31 basic steelmaking facilities and 83 forming and finishing operations. Table II-3 is a listing of those facilities sampled for this study. Table II-4 is a summary of the number of sampled plants and the number of facilities for which the Agency received questionnaire responses.

The primary objective of the field sampling program was to obtain composite samples of wastewaters and flow measurements to determine the concentrations and discharge rates of toxic pollutants. Sampling visits were made during two or three consecutive days of plant operation, with raw wastewater samples taken either before treatment or after minimal preliminary treatment. Treated effluent samples were taken following application of in-place treatment technologies. The Agency also sampled intake waters to determine the presence of toxic pollutants prior to contamination by steel industry processes.

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[3] See EPA 440/1-74-024a; Development Document for Effluent Limitation Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category, June 1974; and EPA 440/1-76/048-d; Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Forming, Finishing and Specialty Steel Segments of the Iron and Steel Manufacturing Point Source Category; March, 1976.

This first phase of the sampling program detected and quantified wastewater constituents included in the list of 129 toxic pollutants. Wherever possible, each sample of an individual raw wastewater stream, a combined waste stream, or a treated effluent was collected by an automatic, time series compositor over three 24-hour sampling periods. Where automatic compositing was not possible, grab samples were taken and composited manually. The purpose of the second phase of the sampling program was to confirm the presence and further quantify the concentrations and waste loadings of the toxic pollutants found during the first phase of the program.

The Agency used the analytical techniques described in Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants, revised April, 1977. Analyses for metals were performed by AA spectrophotometry. However, the standard cold vapor method was used for mercury. This 304(h) method was modified in order to avoid excessive matrix interference that causes high limits of detection. Analyses for total cyanide and cyanide amenable to chlorination were also performed using 304(h) methods.

Analyses for asbestos fibers used transmission electron microscopy with selected area diffraction; results were reported as chrysotile fiber count.

Analyses for conventional pollutants ($BOD_5$, TSS, pH, and oil and grease) and nonconventional pollutants (total residual chlorine, iron, ammonia, fluoride, and COD) were performed using 304(h) methods.

### Industry Subcategorization

The Agency has adopted a revised subcategorization of the steel industry to more accurately reflect production operations in the industry and to simplify the implementation of the regulation. The modified subcategorization is displayed in Table II-5. Table II-6 cross references the modified subcategorization with subparts of the previous regulations. Industry subcategorization is reviewed in detail in Section IV of this report and in Section IV of each subcategory report in the Development Document.

## Regulated Pollutants

The basis upon which the Agency selected the pollutants specifically limited, as well as the general nature and environmental effects of these pollutants is set out in Section V.

## A. BPT

The pollutants limited by this regulation include, for the most part, the same pollutants limited by the remanded BPT regulations. Some pollutants have been deleted from the list of limited pollutants because the sampling conducted subsequent to the promulgation of the prior regulations showed that only very low levels of these pollutants are present in the process wastewaters. For the finishing subcategories, BPT limitations for additional pollutants were promulgated to facilitate the co-treatment of compatible wastewaters and to regulate toxic pollutants where more stringent BAT limitations based upon more advanced wastewater treatment were not promulgated. The discharge of BPT limited pollutants is controlled by 30 day average and maximum daily mass effluent limitations in kilograms per 1000 kilograms (lbs/1000 lbs) of product, and in kilograms per day for fume scrubbers associated with acid pickling and hot coating operations.

## B. BCT

The conventional pollutants controlled by this regulation include TSS, oil and grease, and pH. BCT limitations have been promulgated in seven steel industry subcategories and in all seven of those subcategories BCT is set equal to BPT. Therefore, no additional costs beyond BPT will be incurred to comply with the BCT limitations. In the remaining five subcategories, BCT has been reserved for further consideration.

## C. BAT and NSPS

### 1. Nontoxic, Nonconventional Pollutants

Ammonia-N is a nontoxic, nonconventional pollutant limited by BAT and NSPS.

### 2. Toxic Pollutants

Forty-eight toxic pollutants were found at concentrations above treatability levels in steel industry wastewaters. (Section V contains a list of these pollutants.) Most of the toxic pollutants (29) are found in the cokemaking subcategory. The Agency has promulgated effluent limitations for the following toxic pollutants: total cyanide, benzene, , naphthalene, benzo(a)pyrene, tetrachloroethylene, chromium, lead, nickel, and zinc. These pollutants are subject to numerical limitations expressed in kilograms per 1000 kilograms (lbs/1000 lbs) of product or in kg/day for fume scrubbers associated with acid pickling and hot coating operations. The remaining toxic pollutants, which are not specifically limited, will be controlled by limitations established for "indicator" pollutants (discussed below).

### 3. Indicator Pollutants

The cost of analyses for the many toxic pollutants found in steel industry wastewaters has prompted the Agency to adopt alternative methods of regulating certain toxic pollutants. Instead of promulgating specific effluent limitations for each of the forty-eight toxic pollutants found in steel industry wastewaters at significant levels, the Agency has promulgated effluent limitations for certain "indicator" pollutants. These include chromium, lead, nickel, zinc, phenols (4AAP) and certain toxic organic pollutants. The data available to the Agency generally show that the control of the "indicator" pollutants will result in comparable control of toxic pollutants not specifically limited. By establishing specific limitations for only the "indicator" pollutants, the Agency has reduced the high cost and delays of monitoring and analyses that would result from limitations for each toxic pollutant. The total annual monitoring cost to the industry is estimated to be about \$3.8 million (including \$3.2 million for current monitoring programs). The pollutants found and those that have been specifically limited at the BAT and NSPS levels of treatment are listed in Section V. The bases for selection of "indicator" pollutants is presented in Section X of each subcategory report.

### D. PSES and PSNS

The pollutants for which PSES and PSNS have been promulgated are identical to those limited at BAT and NSPS, with the exception of the conventional pollutants. Limitations were promulgated for certain toxic pollutants, and other "indicator" pollutants to insure against POTW upsets, to prevent accumulation of toxic pollutants in POTW sludges, and primarily to minimize pass-through of certain toxic pollutants. The PSES and PSNS are expressed as 30 day average and maximum daily mass limitations in kilograms per 1000 kilograms (lbs/1000 lbs) of product and in kilograms per day.

## Control and Treatment Technology

### A. Status of In-Place Technology

There are several treatment technologies currently used by the steel industry. Generally, primary wastewater treatment systems rely upon physical/chemical methods including neutralization, sedimentation, flocculation and filtration. Treatment for toxic pollutants includes advanced technologies such as biological oxidation and carbon adsorption. Technologies such as ion exchange, ultrafiltration, multiple-effect evaporation, reverse osmosis, and more sophisticated chemical techniques are generally not currently used in the industry for wastewater treatment applications.

Within the cokemaking subcategory, treatment systems include a component to remove organic wastes. Organic removal steps include biological methods such as bio-oxidation lagoons and activated sludge plants, and physical/chemical methods including ammonia stills, dephenolizers and activated carbon systems. Sedimentation and filtration techniques are also used.

Treatment facilities at plants in the sintering, ironmaking, and steelmaking subcategories include sedimentation and flocculation systems followed by recycle of treated wastewaters. Wastewaters from nearly all hot forming operations are treated in scale pits followed by lagoons, clarifiers, filters, or combinations thereof, with recycle of treated or partially treated wastewaters. Coagulants aids such as lime, alum, polymeric flocculants, and ferric sulfate are normally used in conjunction with clarifiers. Filters are usually of the multi-media pressure type.

Cold finishing treatment techniques include equalization prior to further treatment, neutralization with lime, caustic or acid, flocculation with polymer and sedimentation. Central or combined treatment practices are used widely with these operations.

The use of recycle is a common practice throughout the steel industry. Recycle of treated process wastewaters can be effectively used as a means of significantly reducing discharge loadings to receiving streams. Systems including high recycle rates are demonstrated in several subcategories. Recycle may be applied to specific sources such as barometric condensers (coke) or fume scrubbers (pickling) or to the effluent from final treatment facilities.

## B. Advanced Technologies Considered

The Agency considered advanced treatment systems to control the levels of toxic pollutants at the BAT, NSPS, PSES, and PSNS levels of treatment. Some of these systems include in-plant controls, however, most involve the installation of additional treatment components.

In-plant control has been demonstrated in several subcategories. As a result, such systems have been included in the treatment models at the BAT, BCT, NSPS, PSES, and PSNS levels. Rinse reduction technology, such as cascade rinsing, is a means of reducing wastewater volumes. This technology significantly reduces the volume of wastewater requiring treatment.

Other in-plant control measures such as reduction of wastewater generation by process water reduction and recycle and process modifications have been considered. These control measures are subcategory specific and are discussed in detail in the respective subcategory reports.

Add-on technology to the BPT model technology is also the basis for the BAT, NSPS, PSES, and PSNS levels of treatment. Some of these control measures for toxic pollutants include 2-stage or extended biological treatment (cokemaking); granular activated carbon; pressure filtration; and, multi-stage evaporation/condensation systems. Details on these advanced systems are presented in Section VI.

## Capital and Annual Cost Estimates

Additional expenditures will be required by the steel industry to achieve compliance with the promulgated limitations. A short discussion of the in-place and required capital costs and annual costs are presented below for each level of treatment, based upon the size and status of the industry as of July 1, 1981. All costs are presented in July 1, 1978 dollars.

### A. BPT

The Agency estimates that as of July 1, 1981 the steel industry had expended about $1.5 billion towards compliance with BPT limitations out of a total required cost of $1.7 billion. Industry will incur annualized costs (including interest, depreciation, operating and maintenance) of about $204 million when BPT has been fully implemented. The changes in the above costs are the result of the Agency's update of the status of the industry with respect to BPT compliance and the deletion of plants that have been shutdown.

Compliance with the BPT effluent limitations will result in the removal of about 36,700 tons per year of toxic organic pollutants, 113,500 tons per year of toxic metal pollutants and 13,670,000 tons per year of other pollutants from untreated wastewaters. The Agency believes that these effluent reduction benefits justify the associated costs, and other environmental impacts which are small in relation to these benefits.

### B. BAT

The Agency estimates that as of July 1, 1981, compliance with the BAT and BCT limitations may require the steel industry to invest about $77 million in addition to the BPT investment and to the capital already spent on BAT systems. The annualized costs for the steel industry, in addition to the BPT costs, may equal a total of about $24 million.

Compliance with the BAT limitations will result in the removal of about 580 tons per year of toxic organic pollutants, 190 tons per year of toxic metal pollutants and 12,400 tons per year of other pollutants. The Agency believes that the costs of compliance with the BAT limitations and other environmental impacts are

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Compliance with the BAT limitations will result in the removal of about 580 tons per year of toxic organic pollutants, 190 tons per year of toxic metal pollutants and 12,400 tons per year of other pollutants. The Agency believes that the costs of compliance with the BAT limitations and other environmental impacts are reasonable and justified in light of the effluent reduction benefits obtained.

### C. PSES

The Agency estimates that as of July 1, 1981, compliance with the PSES may require the steel industry to invest about $41 million. The Agency estimates that POTW dischargers have already expended about $132 million for pretreatment facilities. The annualizes costs for the steel industry may equal a total of about $31 million.

Compliance with the PSES will resut in the removal of about 5600 tons/year of toxic organic pollutants, 7850 tons/year of toxic metal pollutants, and 792,000 tons/year of other pollutants from raw wastewaters. The Agency believes that the prevention of toxic pollutant pass through achieved with the promulgated PSES justify the associated costs.

## Basis for Effluent Limitations and Standards

As noted briefly above, the effluent limitations and standards for BPT, BAT, BCT, NSPS, PSES, and PSNS are expressed as mass limitations in kilograms per 1000 kilograms (lbs/1000 lbs) of product and in kilograms per day. The mass limitation is derived by multiplying an effluent concentration (determined from the analysis of treatment system performance) by a model flow appropriate for each subcategory expressed in gallons per/ton of product, or gallons per day. Conversion factors were applied to yield the appropriate kg/kkg (lbs/1000 lbs) and kg/day value for each limited pollutant. The limitations neither require the installation of any specific control technology nor the attainment of any specific flow rate or effluent concentration. Various treatment alternatives or water conservation practices can be employed to achieve a particular effluent limitation and standard. The model treatment systems presented in the development document illustrate one of the means available to achieve the limitations and standards. In most cases, other technologies or operating practices are available to achieve the limitations and standards.

NPDES permit limitations are specified as mass limitations (kg/day or lbs/day). In order to convert the effluent limitations expressed as kg/kkg (lbs/1000 lbs) to a 30-day average or daily maximum permit limit, a production rate in either kkg/day or 1000 lbs/day must be used. The production rates previously used for NPDES permitting have been the highest actual monthly production in the last five years converted to a daily value, or production capacity. Where applicable, the effluent limitations expresses as kg/day are additive to the other permit limitations.

## Suggested Monitoring Program

The suggested long term monitoring and analysis program includes continuous flow monitoring, grab sampling for pH and oil and grease (3 grabs/day, once/week) and the collection of 24-hour composite samples once per week for all other pollutants. The composite samples would be analyzed for those pollutants regulated at the BPT, BAT, BCT, and PSES treatment levels for each contributing subcategory. Due to the relatively high cost of organic analysis ($750-$1000 per sample in July 1978 dollars), monthly monitoring of limited organics in the cokemaking and cold forming subcategories is suggested.

More intensive monitoring is suggested for the period of time necesssary to determine initial compliance with the limitations. Accordingly, as of July 1, 1984, (the compliance date for BAT and BCT), monitoring and analysis should be carried out on a schedule of five daily composites per week (once per week for GC/MS pollutants). When the appropriate regulatory authority determines that compliance has been demonstrated, monitoring can then be decreased to the frequencies indicated in the long term program discussed above.

Although total suspended solids and pH are regulated for each subcategory, the total number of monitored pollutants ranges from three (alkaline cleaning) to eight (cokemaking). The type of analysis influences the overall cost with analysis for toxic organic pollutants being the most expensive, and pH and the metals analyses being the least expensive.

Updated cost estimates were developed using three alternative contractural arrangements (in-house laboratory, contract laboratory, and C.W. Rice Laboratory), to obtain an estimate of the range of monitoring costs and to demonstrate that the monitoring program is feasible with the resources available to the industry.

The subcategory with the largest annual monitoring expenses is cokemaking ($8862-$11,779/yr). The need for the GC/MS organic analyses accounts largely for the high cost. The lowest annual monitoring costs occur in the salt bath descaling-oxidizing subdivision ($2,513-$5,794/yr). Annual monitoring costs for the remaining subcategories are between $2,648 and $11,276.

The total annual monitoring cost to the industry is estimated to be approximately $3.8 million of which $2.3 are expended for monitoring at the BPT and PSES levels. However, actual expenses are likely to be less due to the preponderance of central treatment facilities in this industry. This substantially reduces the number of monitoring points compared to that required with completely separate treatment and monitoring at each process, as assumed by the Agency to estimate the monitoring costs. Total BPT/BAT/PSES annual operating costs are estimated to be $228 million. The monitoring cost is roughly 1.7% of the annual cost of pollution control. The Agency considers these costs reasonable in light of the size and complexity of this industry, and the potential adverse environmental impacts of these discharges.

## Economic Impact on the Industry

The economic impact of the regulation on the steel industry is fully described in Economic Analysis of Effluent Guidelines - Integrated Iron and Steel Industry.

## Energy and Non-water Quality Impacts

The elimination or reduction of one form of pollution may aggravate other environmental problems. Therefore, Sections 304(b) and 306 of the Act require the Agency to consider the non-water quality environmental impacts (including energy requirements) of certain regulations. In compliance with these provisions, the Agency considered the effect of this regulation on air pollution, solid waste generation, water scarcity, and energy consumption. There is no precise methodology for balancing pollution impacts against each other and against energy use. The Agency believes this regulation to be the best possible approach to serving these competing national goals with respect to environmental concerns and energy consumption.

The non-water quality environmental impacts (including energy requirements) associated with the regulation are described in general below and more specifically in the respective subcategory reports.

### A. Air Pollution

Compliance with the BPT, BAT, and BCT limitations and the NSPS, PSES, and PSNS will not create any substantial air pollution problems. However, in several subcategories, slight air impacts may be expected. First, minimal amounts of volatile organic compounds may be released to the atmosphere by aeration in biological treatment systems used for the treatment of cokemaking wastewaters. Secondly, minor particulate air emissions may result as water vapor containing some particulate matter is released from cooling tower systems used in several of the subcategories. None of these impacts are considered significant.

### B. Solid Wastes

EPA estimates that 22.2 million tons per year of solid wastes (at 30% solids for most dewatered sludges) will be generated by the industry when full compliance with BPT, BAT, BCT, and PSES is achieved. Of this amount, 20.0 million tons are generated at the BPT level and 2.2 million tons at PSES. Solid waste generation data by subcategory and by level is summarized in Table II-7. These solid wastes are comprised almost entirely of treatment plant sludges. Much larger quantities of other solid wastes are generated in the steel industry such as electric furnace dust and blast furnace and steelmaking slags. However, these and other solid wastes are generated by the process and not as a result of this water pollution control regulation.

The data gathered for this study demonstrate that most sludges are presently produced by treatment systems already installed in the industry. As a result, the industry is currently incurring disposal costs and finding necessary disposal sites. (It is unknown at this time how many of these disposal sites are secure, well maintained operations.) The cost per ton for disposal is related to the type of waste as well as to the amount. Tonnages to be disposed of in the steel industry are high enough so that lower costs per ton are incurred in relation to most other industries. For this evaluation the Agency, after an extensive evaluation, determined that sludge disposal costs of $5 per ton for non-hazardous wastes and $18 per ton for hazardous wastes are appropriate bases for cost estimating purposes. The costs for disposal of these sludges are included in the Agency's present cost estimate. The Agency has concluded that, the incremental solid waste impacts associated with this regulation will be minimal.

## C. Consumptive Water Loss

The question of water consumption in the steel industry as a result of the installation of wastewater treatment systems is a remand issue of the 1974 and 1976 regulations dealt with in Section III. In summary, the Agency concludes that the water consumed as a result of compliance with this regulation is justified on both a national level and on a "water-scarce" regional level when compared to the effluent reduction benefits achieved.

## D. Energy Requirements

The Agency estimates that compliance with the regulation will result in the consumption of electrical energy, at the BPT, BCT, BAT and PSES levels of treatment as follows:

| Treatment Level | Net Energy Consumption (kwh) |
|---|---|
| BPT/BCT | 1.25 billion |
| BAT | 0.07 billion |
| PSES | 0.12 billion |
| Total | 1.44 billion |

This represents 2.5% of the total 57 billion kwhs of electrical energy consumed by the steel industry in 1978, or about 0.4% of the total energy consumed by the industry. A summary, by subcategory and by level, of energy requirements due to water pollution control is presented in Table II-8. The Agency considers the expenditure of energy required for compliance with this regulation justified by the effluent reductions benefits achieved.

## TABLE II-1

## STANDARD INDUSTRIAL CLASSIFICATION LISTING
## PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY

| Subpart | Applicability; Description | | Standard Industry (1) Classification Codes | |
|---|---|---|---|---|
| Subpart A<br>Cokemaking Subcategory | 420.10 | Applicability; description of the cokemaking subcategory.<br>The provisions of this subpart are applicable to discharges and introduction of pollutants into publicly owned treatment works resulting from by-product and beehive cokemaking operations. | 3312.05<br>3312.11<br>3312.12<br>3312.13<br>3312.14<br>3312.15<br>3312.17<br>3312.52 | Beehive coke products<br>Chem. Rec. Coke<br>Coal gas - coke<br>Coal tar crudes<br>Coke, beehive<br>Chem. coke products<br>Distillates<br>Tar |
| Subpart B<br>Sintering Subcategory | 420.20 | Applicability; description of the sintering subcategory.<br>The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from sintering operations conducted by the heating of iron bearing wastes (mill scale and dust from blast furnaces and steelmaking furnaces) together with fine iron ore, limestone, and coke fines in an ignition furnace and traveling grate to produce an agglomerate for charging to the blast furnace. | 3312.30 | Iron sinter |
| Subpart C<br>Ironmaking Subcategory | 420.30 | Applicability; description of the ironmaking subcategory.<br>The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from ironmaking operations in which iron ore is reduced to molten iron in a blast furnace. | 3312.08<br>3312.19<br>3312.29 | Blast Furnace products<br>Ferroalloys, BF<br>Iron, pig |

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 2

| Subpart | Applicability; Description | | Standard Industry(1) Classification Codes |
|---|---|---|---|
| Subpart D<br>Steelmaking Subcategory | 420.40 | Applicability; description of the steelmaking subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from steelmaking operations conducted in basic oxygen, open hearth, and electric arc furnaces. | 3312.28 Ingots, steel<br>3312.47 Stainless steel<br>3312.58 Tool steel |
| Subpart E<br>Vacuum Degassing Subcategory | 420.50 | Applicability; description of the vacuum degassing subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from vacuum degassing operations conducted by applying a vacuum to molten steel. | |
| Subpart F<br>Continuous Casting Subcategory | 420.60 | Applicability; description of the continuous casting subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from the continuous casting of molten steel into intermediate or semi-finished steel products through water cooled molds. | |

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 3

| Subpart | Applicability; Description | Standard Industry(1) Classification Codes | |
|---|---|---|---|
| Subpart G<br>Hot Forming Subcategory | 420.70 Applicability; description of the hot forming subcategory.<br>The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from hot forming operations conducted in primary, section, flat, and pipe and tube mills. | Primary | |
| | | 3312.06 | Billets, steel |
| | | 3312.09 | Blooms |
| | | 3312.43 | Slabs, steel |
| | | Section | |
| | | 3312.02 | Axles, rolled |
| | | 3312.03 | Bars, iron rolled |
| | | 3312.04 | Bars, steel rolled |
| | | 3312.10 | Carwheels, rolled |
| | | 3312.18 | Fence posts, rolled |
| | | 3312.22 | Frogs |
| | | 3312.26 | Hoops, hot rolled |
| | | 3312.27 | Hot rolled, iron & steel |
| | | 3312.31 | Nut rods, rolled |
| | | 3312.34 | Rail joints, etc. |
| | | 3312.35 | Railroad crossings |
| | | 3312.36 | Rails |
| | | 3312.37 | Rods, rolled |
| | | 3312.38 | Rounds, tube |
| | | 3312.39 | Sheet pilings, rolled |
| | | 3312.41 | Shell slugs, rolled |
| | | 3312.45 | Spike rods, rolled |
| | | 3312.48 | Steel works |
| | | 3312.51 | Structural shapes |
| | | 3312.55 | Tie plates |
| | | 3312.59 | Tube rounds |
| | | 3312.63 | Wheels |
| | | 3312.64 | Wire products |
| | | 3315.01 | Brads, steel |
| | | 3315.02 | Cable, steel |
| | | 3315.03 | Horseshoe, nails |
| | | 3315.04 | Spikes, steel |
| | | 3315.05 | Staples, steel |
| | | 3315.06 | Tacks, steel |

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 4

| Subpart | Applicability; Description | | Standard Industry[1] Classification Codes | |
|---|---|---|---|---|
| Subpart G<br>Hot Forming Subcategory | 420.70 | Applicability; description of the hot forming subcategory. | Section | |
| | | | 3315.07 | Wire, ferrous |
| | | | 3315.08 | Wire products, ferrous |
| | | | 3315.09 | Wire, steel |
| | | | Flat | |
| | | | 3312.01 | Armor plate, rolled |
| | | | 3312.20 | Flats, rolled |
| | | | 3312.33 | Plates, rolled |
| | | | 3312.40 | Sheets, rolled |
| | | | 3312.42 | Skelp |
| | | | 3312.50 | Strips, iron & steel |
| | | | Pipe & Tube | |
| | | | 3312.60 | Tubes, iron & steel |
| | | | 3312.61 | Tubing, seamless |
| | | | 3312.62 | Well casings |
| | | | 3317.03 | Pipe, seamless |
| | | | 3317.05 | Tubes, seamless |
| | | | 3317.07 | Well casing |
| Subpart H<br>Salt Bath Descaling Subcategory | 420.80 | Applicability; description of the salt bath descaling subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from oxidizing and reducing salt bath descaling operations. | | |

## TABLE II-1
## STANDARD INDUSTRIAL CLASSIFICATION LISTING
## PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 5

| Subpart | Applicability; Description | Standard Industry(1) Classification Codes |
|---|---|---|
| Subpart I<br>Acid Pickling Subcategory | 420.90 Applicability; description of the acid pickling subcategory.<br>The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from sulfuric acid, hydrochloric acid, or combination acid pickling operations. | |
| Subpart J<br>Cold Forming Subcategory | 420.100 Applicability; description of the cold forming subcategory.<br>The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works from cold rolling and cold working pipe and tube operations in which unheated steel is passed through rolls or otherwise processed to reduce its thickness to produce a smooth surface, or to develop controlled mechanical properties in the steel. | 3312.07 Blackplate<br>3312.16 Cold Strip Steel<br>3312.32 Pipe<br>3312.65 Wrought pipe, tubing<br>3316.01 Cold finished bars<br>3316.02 Cold rolled strip<br>3316.03 Corrugating CR<br>3316.04 Flat bright CR<br>3316.05 Razor blade strip C<br>3316.06 Sheet steel CR<br>3316.07 Wire, flat<br>3317.01 Boiler tubes<br>3317.02 Conduit<br>3317.04 Pipe, wrought<br>3317.06 Tubing, mechanical<br>3317.08 Wrought pipe & tube |

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 6

| Subpart | Applicability; Description | Standard Industry[1] Classification Codes |
|---|---|---|
| Subpart K<br>Alkaline Cleaning Subcategory | 420.110 Applicability; description of the alkaline cleaning subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from operations in which steel and steel products are immersed in alkaline cleaning baths to remove mineral and animal fats or oils from the steel, and those rinsing operations which follow such immersion. | |
| Subpart L<br>Hot Coating Subcategory | 420.120 Applicability; description of the hot coating subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from the operations in which steel is coated with zinc, terne metal, or other metals by the hot dip process, and those rinsing operations associated with that process. | 3312.23 Galvanized products<br>3312.25 Hoop, hot galvanized rolled<br>3312.49 Strips, galvanized<br>3312.53 Terneplate<br>3312.54 Ternes<br>3312.57 Tin plate<br>3479.04 Coating (hot dipped)<br>3479.12 Galvanizing |

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(1) The EPA has added decimal digits to the standard four digit SIC code for easy reference to individual products.

## TABLE II-2

## SUBCATEGORY INVENTORY

| Subcategory | No. of Active Plants(1) | No. of Individual Units(2) | No. of Plants Direct Discharging | No. of Plants Discharging to POTWs | No. of Plants With Zero Discharges |
|---|---|---|---|---|---|
| A. Cokemaking | | | | | |
| 1. Iron & Steel | 39 | 64 | 15 | 8 | 16(3) |
| 2. Merchant | 19 | 21 | 7 | 8 | 4(3) |
| B. Sintering | 17 | 17 | 15 | 1 | 1 |
| C. Ironmaking | 45 | 161 | 39 | 2 | 4 |
| D. Steelmaking | | | | | |
| 1. BOF | | | | | |
| a. Semi-wet | 9 | 9(20) | 8 | 0 | 1 |
| b. Wet-suppressed | 6 | 6(15) | 5 | 1 | 0 |
| c. Wet-open | 14 | 15(35) | 13 | 1 | 0 |
| 2. Open Hearth - Wet | 4 | 4(28) | 4 | 0 | 0 |
| 3. Electric Arc Furnace | | | | | |
| a. Semi-wet | 3 | 3(8) | 2 | 0 | 1 |
| b. Wet | 7 | 9(20) | 6 | 1 | 0 |
| E. Vacuum Degassing | 33 | 38 | 31 | 0 | 2 |
| F. Continuous Casting | 49 | 59 | 25 | 7 | 17 |

TABLE II-2
SUBCATEGORY INVENTORY
PAGE 2

| Subcategory | No. of Active Plants(1) | No. of Individual Units(2) | No. of Plants Direct Discharging | No. of Plants Discharging to POTWs | No. of Plants With Zero Discharges |
|---|---|---|---|---|---|
| G. Hot Forming | | | | | |
| 1. Primary | 84 | 113 | 76 | 6 | 2 |
| 2. Section | 80 | 241 | 65 | 8 | 7 |
| 3. Flat | | | | | |
| a. Hot Strip & Sheet | 39 | 55 | 37 | 2 | 0 |
| b. Plate | 17 | 25 | 16 | 1 | 0 |
| 4. Pipe & Tube | 34 | 50 | 33 | 1 | 0 |
| H. Salt Bath Descaling | | | | | |
| 1. Oxidizing | 19 | 24 | 17 | 2 | 0 |
| 2. Reducing | 7 | 8 | 6 | 1 | 0 |
| I. Acid Pickling | | | | | |
| 1. Sulfuric Acid | 124 | 191 | 71 | 34 | 19(4) |
| 2. Hydrochloric Acid | 46 | 98 | 34 | 12 | 0 |
| 3. Combination Acid | 67 | 129 | 46 | 18 | 3 |

TABLE II-2
SUBCATEGORY INVENTORY
PAGE 3

| Subcategory | No. of Active Plants(1) | No. of Individual Units(2) | No. of Plants Direct Discharging | No. of Plants Discharging to POTWs | No. of Plants With Zero Discharges |
|---|---|---|---|---|---|
| J. Cold Forming | | | | | |
| 1. Cold Rolling | | | | | |
| a. Recirculation | 53 | 142 | 34 | 6 | 13(4) |
| b. Combination | 10 | 21 | 10 | 0 | 0 |
| c. Direct Application | 21 | 67 | 19 | 0 | 2(4) |
| 2. Pipe & Tube | | | | | |
| a. Water | 15 | 72 | 9 | 2 | 4(4) |
| b. Oil Emulsions | 19 | 52 | 2 | 0 | 17(4) |
| K. Alkaline Cleaning | | | | | |
| 1. Batch | 31 | 51 | 22 | 9 | 0 |
| 2. Continuous | 31 | 123 | 22 | 9 | 0 |
| L. Hot Coatings | | | | | |
| 1. Galvanizing | 63 | 146 | 40 | 17 | 6 |
| 2. Terne | 5 | 6 | 4 | 1 | 0 |
| 3. Other Metals | 10 | 18 | 5 | 4 | 1 |
| TOTAL | 1020 | 2023 | 741 | 162 | 117 |

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( ) For steelmaking operations, the numbers in parentheses represent the number of furnaces at the specified number of shops.

(1) Active as of 7/1/81.

(2) Multiple operating units or pollution control facilities within a subcategory may exist at a plant site.

(3) These coke plant operations achieve zero discharge either by disposing of their effluent via quenching or deep well disposal.

(4) These plants achieve zero discharge by having their wastewater hauled off-site.

TABLE II-3

PLANTS SAMPLED DURING IRON AND STEEL STUDY

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| A. Cokemaking | | | | |
| 1. By-Product | 001(1) | 0732A | Shenango (Neville Island) | |
| | 002 | 0464C | Koppers (Erie) | |
| | 003(1)(2) | 0868A | U.S.S. (Fairfield) | |
| | NA | 0860H | U.S.S. (South Works) | |
| | 006 | 0584B | National Steel (Great Lakes) | |
| | 007 | 0320 | Ford Motor Co. (Dearborn) | |
| | 008 | 0920F | Wheeling-Pit (Follansbee) | |
| | 009(1) | 0684F | Republic STeel (Cleveland) | |
| | NA | 0402 | Ironton Coke (Ironton) | |
| | A | 0432B | J & L (Pittsburgh) | |
| | B | 0112 | Bethlehem (Bethlehem) | |
| | C | 0384A | Inland (East Chicago) | |
| | D | 0272 | Donner-Hanna (Buffalo) | |
| 2. Beehive | E | 0428A | Jewell (Vansant) | |
| | F | 0428A | Jewell (Vansant) | |
| | G | 0724A | Sharon (Carpenter) | |
| B. Sintering | | | | |
| | 016 | 0112D | Bethlehem (Burns Harbor) | |
| | 017 | 0432A | J & L (Aliquippa) | |
| | 019 | 0060F | Armco (Houston) | |
| | H | 0432A | J & L (Aliquippa) | |
| | I | 0291C | International Harvester (Chicago) | |
| | J | 0396A | Interlake (Chicago) | |
| | K | 0112B | Bethlehem (Buffalo-Lackawanna) | |
| C. Ironmaking | | | | |
| | 021 | 0196A | CF&I (Pueblo) | Iron |
| | 022 | 0856N | U.S.S. (Lorain) | Iron |
| | 023 | 0860B | U.S.S. (Gary Works) | Iron |
| | 024 | 0860H | U.S.S. (Chicago-South) | Iron |
| | 025 | 0112C | Bethlehem (Johnstown) | Iron |
| | 026 | 0112D | Bethlehem (Burns Harbor) | Iron |
| | 027 | 0432A | J & L (Aliquippa) | Iron |
| | 028 | 0684H | Republic (Chicago) | Iron |
| | 029 | 0684F | Republic (Cleveland) | Iron |
| | 030 | 0112 | Bethlehem (Bethlehem) | Iron |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 2

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| | L | 0291C | International Harvester (Chicago) | Iron |
| | M | 0396A | Interlake (Chicago) | Iron |
| | N | 0448A | Kaiser (Fontana) | Iron |
| | O | 0060F | Armco (Houston) | Iron |
| | P | 0112B | Bethlehem (Buffalo-Lackawanna) | Iron |
| | Q | 0112C | Bethlehem (Johnstown) | FeMn |
| D. Steelmaking | | | | |
| 1. BOF | 031 | 0020B | Allegheny-Ludlum (Brackenridge) | W-OC |
| | 032 | 0384A | Inland (Indiana Harbor) | W-SC |
| | 033 | 0856B | U.S.S. (Edgar Thompson) | W-OC |
| | 034 | 0856N | U.S.S. (Lorain) | W-SC |
| | 035 | 0868A | U.S.S. (Fairfield) | W-OC |
| | 036 | 0112D | Bethlehem (Burns Harbor) | W-OC |
| | 038 | 0684F | Republic (Chicago) | W-SC |
| | D* | 0248A | Crucible (Midland) | W-OC |
| | R | 0432A | J & L (Aliquippa) | Semi-wet |
| | S | 0060 | Armco (Middletown) | W-SC |
| | T | 0112A | Bethlehem (Sparrows Point) | W-OC |
| | U | 0396D | Interlake (Chicago) | Semi-Wet |
| | V | 0584F | National (Weirton) | W-OC |
| 2. Open Hearth | 042 | 0492A | Lone Star (Lone Star) | Wet |
| | 043 | 0864A | U.S.S. (Provo) | Semi-wet |
| | W | 0112A | Bethlehem (Sparrows Point) | Wet |
| | Y | 0060 | Armco (Middletown) | Wet |
| 3. Electric Arc Furnace | 051 | 0612 | Northwestern Steel & Wire (Sterling) | Wet |
| | 052 | 0492A | Lone Star (Lone Star) | Wet |
| | 059B | 0060F | Armco (Houston) | Semi-wet |
| | AA | 0060F | Armco (Houston) | Wet |
| | AB | 0868B | U.S.S. (Texas Works, Baytown) | Wet |
| | Y | 0432C | J & L (Cleveland) | Semi-wet |
| | Z | 0584A & B | National (Ecorse) | Semi-wet |
| E. Vacuum Degassing | | | | |
| | 062 | 0496 | Lukens (Coatesville) | |
| | 065 | 0584F | National (Weirton) | |
| | 068 | 0684H | Republic (Chicago) | |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 3

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| | AC | 0584F | National (Weirton) | |
| | AD | 0868B | U.S.S. (Texas Works, Baytown) | |
| | E | 0020B | Allegheny-Ludlum (Brackenridge) | |
| | G | 0856R | U.S.S. (Duquesne) | |
| F. Continuous Casting | | | | |
| | 071 | 0284A | Eastern Stainless (Baltimore) | |
| | 072 | 0496 | Lukens (Coatesville) | |
| | 075 | 0584F | National (Weirton) | |
| | 079 | 0060K | Armco (Marion) | |
| | AE | 0584F | National (Weirton) | |
| | AF | 0868B | U.S.S. (Texas Works, Baytown) | |
| | B* | 0900 | Washington Steel (Washington) | |
| | D* | 0248A & B | Crucible (Midland) | |
| | Q* | 0684D | Republic (Massilon) | |
| G. Hot Forming | | | | |
| 1. Primary | 081 | 0176 | Carpenter Technology (Reading) | Bloom |
| | 082 | 0496 (140" only) | Lukens (Coatesville) | Slab/Rough Plate |
| | 082 | 0496 (140",206" in tandem) | Lukens (Coatesville) | Slab/Rough Plate |
| | 083 | 0860H | U.S.S. (South Chicago) | Slab/Bloom |
| | D* | 0248B | Crucible (Midland) | Slab |
| | E* | 0020B | Allegheny-Ludlum (Brackenridge) | Slab |
| | H* | 0248A | Crucible (Midland) | Bloom |
| | K* | 0256K | Universal Cyclops (Bridgeville) | Slab/Bloom |
| | M* | 0432J | J & L (Warren) | Slab/Bloom |
| | Q* | 0684D | Republic (Massillon) | Bloom |
| | R* | 0240A | Copperweld (Warren) | Bloom |
| | A-2 | 0112B | Bethlehem (Lackawanna) | Bloom |
| | B-2 | 0112B | Bethlehem (Lackawanna) | Slab |
| | C-2 & 088 (Revisited) | 0684H | Republic (Chicago) | Bloom |
| | D-2 | 0946A | Wisconsin (Chicago) | Bloom |
| | L-2 | 0060 | Armco (Middletown) | Slab |
| | 285A(2) | 0240A | Copperweld (Warren) | Bloom |
| | 286A(2) | 0432C | J & L (Cleveland) | Slab |
| | 288A(2) | 0584F | National (Weirton) | Slab/Bloom |
| | 289A(2) | 0684B | Republic (Warren) | Bloom |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 4

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| | 290A$^{(2)}$ | 0856R | U.S.S. (Duquesne) | Slab/Bloom |
| | 291$^{(2)}$ | 0856B | U.S.S. (Edgar Thompson) | |
| | 293A$^{(2)}$ | 0856N | U.S.S. (Lorain) | Slab/Bloom |
| | 294A$^{(2)}$ | 0920N | Wheeling Pittsburgh (Mingo Jct.) | Slab |
| 2. Section | 083 | 0860H (02 & 03) | U.S.S. (South Chicago) | 34" & Rod Mill |
| | 087 | 0432-02 | J & L (Aliquippa) | 14" Mill |
| | 088 | 0684H-02 | Republic (Chicago) | 34" Mill |
| | 088 | 0684H (01,03,05,06,07) | Republic (Chicago) | 36",32",14", 10",11" Mills |
| | C* | 0424 (01-03) | Jessop (Washington) | Bar Mills |
| | H* | 0248A | Crucible (Midland) | Merchant Mill |
| | K* | 0256K | Universal Cyclops (Bridgeville) | Bar Mill |
| | M* | 0432J | J & L (Warren) | Billet Mill |
| | O* & 081 (Revisited) | 0176 (01-03) | Carpenter Technology (Reading) | Bar Mills |
| | A-2 | 0112B | Bethlehem (Lackawanna) | Rail Mill |
| | D-2 | 0946A | Wisconsin (Chicago) | #2, 5, & 6 Mills |
| | E-2 | 0196A (09 & 10) | CF&I (Pueblo) | Bar & Rod Mills |
| | F-2 | 0384A-06 | Inland (East Chicago) | 12" Bar Mill |
| | G-2 | 0652A (01 & 02) | Penn-Dixie (Joliet) | 10" & 12" Mills |
| | H-2 | 0432A-04 | J & L (Aliquippa) | Rod Mill |
| | I-2 | 0856O | U.S.S. (Cleveland) | Rod Mill |
| | 282B$^{(2)}$ | 0088A | Babcock & Wilcox (Koppel) | Round Mill |
| | 283$^{(2)}$ | 0112 | Bethlehem (Bethlehem) | |
| | 285B$^{(2)}$ | 0240A | Copperweld (Warren) | Round Mill |
| | 290B$^{(2)}$ | 0856R | U.S.S. (Duquesne) | |
| | 293B$^{(2)}$ | 0856N | U.S.S. (Lorain) | Rebar Mill |
| 3. Flat | 082 | 0496 (01 & 03) | Lukens (Coatesville) | 140",112"/120", 140"/206" |
| | 082 | 0496 (02 & 04) | Lukens (Coatesville) | 112"/120",140" Mills |
| | 083 | 0860H-01 | U.S.S. (South Chicago) | 30" Plate Mill |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 5

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
|  | 086 | 0112D-01 | Bethlehem (Burns Harbor) | 160" Plate Mill |
|  | 086 | 0112D-02 | Bethlehem (Burns Harbor) | 80 " Hot Strip |
|  | 087 | 0432A | J & L (Aliquippa) | 44" Hot Strip |
|  | D* | 0248B | Crucible (Midland) | Hot Strip |
|  | E* | 0020B | Allegheny-Ludlum (Brackenridge) | Hot Strip |
|  | F* | 0856H | U.S.S. (Homestead) | 160" Plate Mill |
|  | O | 0176 | Carpenter Technology (Reading) | #4 Hot Mill |
|  | J-2 | 0860B-01 | U.S.S. (Gary Works) | 84" Hot Strip |
|  | K-2 | 0868B | U.S.S. (Baytown) | 160" Plate Mill |
|  | L-2 | 0060 | Armco (Middletown) | Hot Strip & Sheet |
|  | M-2 | 0384A-02 | Inland (East Chicago) | 80" Hot Strip |
|  | N-2 | 0396D-02 | Interlake (Riverdale) | #4 Hot Strip |
|  | 281(2) | 0020B | Allegheny Ludlum (Brackenridge) | Hot Strip |
|  | 284(2) | 0112D | Bethlehem (Burns Harbor) | Hot Strip & Plate |
|  | 286B(2) | 0432C | J & L (Cleveland) | Hot Strip |
|  | 287(2) | 0584B | National (Ecorse) | Hot Strip |
|  | 288B(2) | 0584F | National (Weirton) | Hot Strip |
|  | 289B(2) | 0684B | Republic (Warren) | Hot Strip |
|  | 292(2) | 0860B | U.S.S. (Gary) | Hot Strip |
|  | 294B(2) | 0920N | Wheeling Pittsburgh (Mingo Jct.) | Hot Strip |
| 4. Pipe and Tube | 087 | 0432A-01 | J & L (Aliquippa) | Butt Weld |
|  | 088 | 0684H | Republic (Chicago) | Seamless |
|  | E-2 | 0196A-01 | CF&I (Pueblo) | Seamless |
|  | GG-2 | 0240B-05 | Ohio Steel & Tube (Shelby) | Seamless |
|  | II-2 | 0916A | Wheatland (Wheatland) | Butt Weld |
|  | JJ-2 | 0728 | Sharon (Sharon) | Butt Weld |
|  | KK-2 | 0256G | Cyclops (Sawhill) | Butt Weld |
|  | 293C(2) | 0856N | U.S.S. (Lorain) | Seamless |
|  | 295(2) | 0948A | J & L (Campbell) | Seamless |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 6

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| H. Salt Bath Descaling | | | | |
| 1. Oxidizing | 131 | 0424 | Jessop (Washington, Pennsylvania) | Plate |
| | 132 | 0176-04 | Carpenter Technology (Reading) | Rod, Wire |
| | 138 | 0440A | Joslyn (Fort Wayne) | Bar, Rod |
| | C* | 0424 | Jessop (Washington, Pennsylvania) | Plate |
| | L* | 0440A | Joslyn (Fort Wayne) | Bar,Rod |
| 2. Reducing | 132 | 0176 (01-03) | Carpenter Technology (Reading) | Bar,Rod Strip,Wire |
| | 139 | 0256N | Universal Cyclops (Titusville) | Bar,Billet |
| | L* | 0440A | Joslyn (Fort Wayne) | Bar,Rod |
| | Q* | 0684D | Republic (Massillon) | Strip |
| I. Acid Pickling | | | | |
| 1. Sulfuric Acid | 092 | 088A | B&W (Beaver Falls) | B |
| | 094 | 0948C | YS&T (Indiana Harbor) | C-N |
| | 095 | 0584E | National (Midwest) | C |
| | 096 | 0112I | Bethlehem (Lebanon) | B-N |
| | 097 | 0760 | Stanley (New Britain) | C-AU |
| | 098 | 0684P | Republic (Massillon) | B |
| | R* | 0240A | Copperweld (Warren) | B-N |
| | H-2 | 0432A | J & L (Aliquippa) | B-N, C-N |
| | I-2 | 0856P | U.S.S. (Cleveland) | B |
| | O-2 | 0590 | Nelson Steel (Chicago) | B-AU |
| | P-2 | 0312 | Fitzsimons (Youngstown) | B-AU |
| | Q-2 | 0894 | Walker Steel & Wire (Ferndale) | B-AU |
| | R-2 | 0240B | Ohio Sheet & Tube (Shelby) | B-N |
| | S-2 | 0256G | Cyclops-Sawhill (Sharon) | B-N |
| | T-2 | 0792B | Thompson Steel (Chicago) | C-AU |
| | QQ-2 | 0584E | National (Midwest) | C-N |
| | SS-2 | 0112A | Bethlehem (Sparrows Pt.) | C-N |
| | TT-2 | 0856D | U.S.S. (Irwin) | C-N |
| | WW-2 | 0868A | U.S.S. (Fairfield) | C-N |
| 2. Hydrochloric Acid | 091 | 0612 | Northwestern S&W (Sterling) | C-N |
| | 093 | 0396D | Interlake (Riverdale) | C-N |
| | 095 | 0584F | National (Weirton) | C-AR |
| | 099 | 0528B | McLouth (Gibralter) | C-AR |
| | 100 | 0384A | Inland (East Chicago) | C-N |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 7

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| | I-2 | 0856P | U.S.S. (Cuyahoga) | C-N |
| | U-2 | 0480A | LaSalle (Hammond) | B-N |
| | V-2 | 0936 | Wire Sales, Inc. (Chicago) | B-N |
| | W-2 | - | Dominion (Hamilton) | C-AR |
| | X-2 | 0060B | Armco (Ashland) | C-AR |
| | Y-2 | - | Steel Co. of Canada (Hamilton) | C-AR |
| | Z-2 | 0396D | Interlake (Riverdale) | C-N |
| | AA-2 | 0384A | Inland (East Chicago) | C-N |
| | BB-2 | 0060 | Armco (Middletown) | C-N |
| 3. Combination Acid | 121 | 0900 | Washington Steel (Washington) | C-N |
| | 122 | 0176 | Carpenter Technology | B-N |
| | 123 | 0088A | Babcock & Wilcox (Beaver Falls) | B-N |
| | 124 | 0088D | Babcock & Wilcox (Koppel) | B-N |
| | 125 | 0674E | Plymouth Tube (Dunkirk) | B-N |
| | A* | 0900 | Washington Steel (Washington) | C-N |
| | C* | 0424 | Jessop (Washington, Pennsylvania) | B-N |
| | D* | 0248A & B | Crucible (Midland) | C-N |
| | F* | 0856H | U.S.S. (Homestead) | B-N |
| | I* | 0432K | J & L (Louisville) | C-N |
| | L* | 0440A | Joslyn (Fort Wayne) | B-N |
| | O* | 0176 | Carpenter Technology | C-N |
| | U* | 00600 | Tube Associates (Houston) | B-N |
| J. Cold Forming | | | | |
| 1. Cold Rolling | 101 A & B(1) | 0020 B & C | Allegheny-Ludlum (W. Leechburg) | Recirc. |
| | 102 | 0384A | Inland (East Chicago) | Recirc. |
| | 105 | 0584F | National (Weirton) | Direct Appl. |
| | 105 | 0584F | National (Weirton) | Recirc. |
| | 106 | 0112B | Bethlehem (Lackawanna) | Direct Appl. |
| | D* | 0248B | Crucible (Midland) | Recirc. |
| | I* | 0432K | J & L (Louisville) | Recirc. |
| | P* | 0156B | Cabot Steel (Kokomo) | Recirc. |
| | X-2 | 0060B | Armco (Ashland) | Recirc. |
| | BB | 0060 | Armco (Middleton) | Recirc. |
| | DD-2 | 0584E | National (Midwest) | Combination |
| | EE-2 | 0112D | Bethlehem (Burns Harbor) | Recirc. |
| | FF-2 | 0384A | Inland (East Chicago) | Recirc. |
| | VV-2 | 0584F | National (Weirton) | Direct Appl. |
| | XX-2 | 0684I | Republic (Gadsden) | Recirc. |
| | YY-2 | 0432D | J & L (Hennepin) | Combination |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 8

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
| | 301(2) | 0020B | Allegheny Ludlum (W. Leechburg) | Recirc. |
| | 302(2) | 0060E | Armco (Zanesville) | Recirc. |
| | 304(2) | 0176 | Carpenter Technology (Reading) | Recirc. & Direct Appl. |
| | 305(2) | 0176 | Carpenter Technology (Reading) | Recirc. & Direct Appl. |
| | 306(2) | 0248B | Crucible (Midland) | Recirc. |
| | 307(2) | 0248B | Crucible (Midland) | Recirc. |
| | 308(2) | 0320 | Ford Motor Co (Dearborn) | Recirc. |
| | 310(2) | 0432C | J & L (Cleveland) | Recirc. |
| | 311(2) | 0432D | J & L (Hennepin) | Combination |
| | 312(2) | 0948C | J & L (E. Chicago) | Combination |
| | 313(2) | 0584B | National Steel (Detroit) | Combination |
| | 315(2) | 0684 | Republic Steel (Cleveland) | Recirc. |
| | 316(2) | 0684B | Republic Steel (Warren) | Recirc. |
| | 318(2) | 0856P | U.S.S. (Cuyahoga Works) | Recirc. |
| | 319(2) | 0856F | U.S.S. (Fairless) | Combination |
| | 321(2) | 0684D | Republic Steel (Massillon) | Recirc. |
| | 323(2) | 0060 | Armco Steel (Middletown) | Recirc. |
| 2. Pipe & Tube | HH-2 | 0492A | Lone Star Steel (Lone Star) | Water |
| | 331(2) | 0256G | Cyclops (Sharon) | Water & Oil |
| | 332(2) | 0684L | Republic (Elyria OH) | Oil |
| | 333(2) | 0684A | Republic (Youngstown) | Oil |
| | 335(2) | 0856N | U.S.S. (Lorain) | Oil |
| | 336(2) | 0856Q | U.S.S. (McKeesport) | Water & Oil |
| | 337(2) | 0678C | Quanex (Shelby) | Oil |
| | 338(2) | 0240B | Copperweld (Shelby) | Oil |
| K. Alkaline Cleaning | 152 | 0176 | Carpenter Technology (Reading) | Continuous |
| | 156 | 0112I | Bethlehem (Lebanon) | Batch & Cont. |
| | 157 | 0432K | J & L (Louisville) | Cont. |
| | I* | 0432K | J & L (Louisville) | Cont. |
| | 317(2) | 0796A | Timken (Canton) | Batch |
| L. Hot Coating | | | | |
| 1. Galvanizing | 111 | 0612 | Northwestern Steel (Sterling) | |
| | 112 | 0396D | Interlake (Riverdale) | |
| | 114 | 0948C | YS&T (East Chicago) | |
| | 116 | 0112I | Bethlehem (Lebanon) | |

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 9

| Subcategory | Sampling Code | Plant Reference Code | Plant Name | Type of Operation |
|---|---|---|---|---|
|  | 118 | 0920E | Wheeling-Pitt (Martins Ferry) |  |
|  | 119 | 0476A | Laclede (Alton) |  |
|  | I-2 | 0856O | U.S.S. (Cleveland) |  |
|  | V-2 | 0936 | Wire Sales (Chicago) |  |
|  | MM-2 | 0856F | U.S.S. (Fairless) |  |
|  | NN-2 | 0920E | Wheeling-Pitt (Martins Ferry) |  |
| 2. Terne | 113 | 0856D | U.S.S. (Irwin) |  |
|  | OO-2 | 0060R | Armco (Middletown) |  |
|  | PP-2 | 0856D | U.S.S. (Irwin) |  |
| 3. Other | 116 | 0112I | Bethlehem (Lebanon) | Aluminum |

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(1) Data exists for more than one visit.
(2) Verification analyses protocol used at this plant visit.
NA: Sample code number was not assigned.
*: Sampled by Datagraphics.

Key to Abbreviations:

W-OC: "Wet-Open Combustion" type air pollution control system.
W-SC: "Wet-Suppressed Combustion" type air pollution control system
B : Batch
C : Continuous
AU : Acid Recovery
AR : Acid Regeneration

## TABLE II-4

## INDUSTRY-WIDE DATA BASE
## IRON & STEEL INDUSTRY

| | No. of Operations |
|---|---|
| Number Sampled for Original Guidelines Study | 133 |
| Number Sampled for Toxic Pollutant Studies | 161 |
| Total Number Sampled (Not including re-visits) | 244 |
| Number Responding to the D-DCP's | 174 incl.<br>44 above |
| Total Number Sampled or Surveyed via D-DCP's | 374 |
| Number Responding to the DCP's | 2023 |

## TABLE II-5

## REVISED STEEL INDUSTRY SUBCATEGORIZATION

A. Cokemaking

    1. Byproduct

        a. Iron & Steel - Biological
        b. Iron & Steel - Physical Chemical
        c. Merchant - Biological
        d. Merchant - Physical Chemical

    2. Beehive

B. Sintering

C. Ironmaking
    1. Iron
    2. Ferromanganese (BPT only)

D. Steelmaking

    1. BOF

        a. Semi-wet
        b. Wet - Open Combustion
        c. Wet - Suppressed Combustion

    2. Open Hearth - Wet

    3. Electric Arc Furnace

        a. Semi-wet
        b. Wet

E. Vacuum Degassing

F. Continuous Casting

G. Hot Forming

    1. Primary

        a. Carbon and Specialty w/o scarfing
        b. Carbon and Specialty w/scarfing

    2. Section

        a. Carbon
        b. Specialty

TABLE II-5
REVISED STEEL INDUSTRY SUBCATEGORIZATION
PAGE 2

3. Flat

   a. Hot Strip and Sheet (Carbon and Specialty)
   b. Plate - Carbon
   c. Plate - Specialty

4. Pipe and Tube

H. Salt Bath Descaling

   1. Oxidizing

      a. Batch Sheet/Plate
      b. Batch Rod/Wire/Bar
      c. Batch Pipe/Tube
      d. Continuous

   2. Reducing

      a. Batch
      b. Continuous

I. Acid Pickling

   1. Sulfuric Acid

      a. Rod, Wire and Coil
      b. Bar, Billet, and Bloom
      c. Strip, Sheet and Plate
      d. Pipe, Tube and Other Products
      e. Fume Scrubber

   2. Hydrochloric Acid

      a. Rod, Wire and Coil
      b. Strip, Sheet and Plate
      c. Pipe, Tube and Other Products
      d. Fume Scrubber
      e. Acid Regeneration

   3. Combination Acid Pickling

      a. Rod, Wire and Coil
      b. Bar, Billet, and Bloom
      c. Cont. - Strip, Sheet and Plate
      d. Batch - Strip, Sheet and Plate
      e. Pipe, Tube and Other Products
      f. Fume Scrubber

TABLE II-5
REVISED STEEL INDUSTRY SUBCATEGORIZATION
PAGE 3

J. Cold Forming

   1. Cold Rolling

      a. Recirculation - Single Stand
      b. Recirculation - Multi Stand
      c. Combination
      d. Direct Application - Single Stand
      e. Direct Application - Multi Stand

   2. Pipe and Tube

      a. Water
      b. Oil Emulsion

K. Alkaline Cleaning

   1. Batch
   2. Continuous

L. Hot Coatings

   1. Galvanizing, Terne & Other
   2. Fume Scrubber

## TABLE II-6

## CROSS REFERENCE OF REVISED STEEL INDUSTRY SUBCATEGORIZATION TO PRIOR SUBCATEGORIZATION

| Revised Subcategorization | Prior Subcategorization (1974 and 1976 Regulations) | Remarks |
|---|---|---|
| A. Cokemaking | A. By-Product Coke | |
| 1. By-Product | B. Beehive Coke | |
| a. Iron & Steel - Biological | | |
| b. Iron & Steel - Physical Chemical | | |
| c. Merchant - Biological | | Segment Added |
| d. Merchant - Physical Chemical | | Segment Added |
| 2. Beehive | | |
| B. Sintering | C. Sintering | |
| C. Blast Furnace | D. Blast Furnace - Iron | |
| 1. Iron | E. Blast Furnace - FeMn | |
| 2. Ferromanganese (BPT only) | | |
| D. Steelmaking | | |
| 1. BOF | F. BOF - Semi-wet | |
| a. Semi-wet | G. BOF - Wet | |
| b. Wet - Open Combustion | | Segment Added |
| c. Wet - Suppressed Combustion | | Segment Added |
| 2. Open Hearth - Wet | H. Open Hearth - Wet | |
| 3. EAF | I. EAF - Semi-wet | |
| a. Semi-wet | J. EAF - Wet | |
| b. Wet | | |
| E. Vacuum Degassing | K. Vacuum Degassing | |
| F. Continuous Casting | L. Continuous Casting | |
| G. Hot Forming | M. Hot Forming - Primary | |
| 1. Primary | 1. Carbon wo/scarfers | Segments |
| | 2. Carbon w/scarfers | Changed |
| a. Carbon and Specialty wo/scarfers | 3. Specialty | |
| b. Carbon and Specialty w/scarfers | | |

TABLE II-6
CROSS REFERENCE OF REVISED STEEL INDUSTRY
SUBCATEGORIZATION TO PRIOR SUBCATEGORIZATION
PAGE 2

| Revised Subcategorization | Prior Subcategorization (1974 and 1976 Regulations) | Remarks |
|---|---|---|
| 2. Section | N. Hot Forming - Section | |
| a. Carbon | 1. Carbon | |
| b. Specialty | 2. Specialty | |
| 3. Flat | O. Hot Forming - Flat | |
| a. Hot Strip and Sheet | 1. Hot Strip & Sheet | |
| b. Plate - Carbon | 2. Plate | |
| c. Plate - Specialty | | |
| | P. Hot Forming - Pipe and Tube | |
| 4. Pipe and Tube | 1. Isolated<br>2. Integrated | Segment Changed |
| H. Scale Removal | X. Scale Removal | |
| 1. Oxidizing | | |
| a. Batch Sheet/Plate | a. Kolene | Segments Changed |
| b. Batch Rod/Wire/Bar | | |
| c. Batch Pipe/Tube | | |
| d. Continuous | | |
| 2. Reducing | b. Hydride | Segments Changed |
| a. Batch | | |
| b. Continuous | | |
| I. Acid Pickling | Q. Pickling - Sulfuric Acid - Batch and Continuous | |
| 1. Sulfuric Acid | | |
| a. Rod, Wire and Coil | a. Batch - spent liquor, no rinses | Segments Changed |
| b. Bar, Billet and Bloom | b. Continuous - Neutralization (liquor) | |
| c. Strip, Sheet and Plate | | |
| d. Pipe, Tube and Other Products | c. Continuous - Neutralization (R, FHS) | |
| e. Fume Scrubber | | |
| 2. Hydrochloric Acid | d. Continuous - Acid Recovery (new facilities) | |
| a. Rod, Wire and Coil | | |
| b. Strip, Sheet and Plate | R. Pickling - Hydrochloric Acid - Batch and Continuous | |
| c. Pipe, Tube and Other Products | | |
| d. Fume Scrubber | | |
| e. Acid Regeneration | a. Concentrates - nonregenerative | Segments Changed |
| | b. Regeneration | |
| | c. Rinses | |
| | d. Fume hood scrubbers | |

TABLE II-6
CROSS REFERENCE OF REVISED STEEL INDUSTRY
SUBCATEGORIZATION TO PRIOR SUBCATEGORIZATION
PAGE 3

| Revised Subcategorization | Prior Subcategorization (1974 and 1976 Regulations) | Remarks |
|---|---|---|
| 3. Combination Acid | W. Combination Acid Pickling (Batch and Continuous) Subcategory | Segments Changed |
| a. Rod, Wire and Coil | | |
| b. Bar, Billet and Bloom | | |
| c. Cont. - Strip, Sheet and Plate | a. Continuous | |
| d. Batch - Strip, Sheet and Plate | b. Batch - Pipe and Tube | |
| e. Pipe, Tube and Other Products | c. Batch - other | |
| f. Fume Scrubber | | |
| J. Cold Forming | S. Cold Rolling | |
| 1. Cold Rolling | | |
| a. Recirculation - Single Stand | a. Recirculation | Segments Added |
| b. Recirculation - Multi Stand | | |
| c. Combination | b. Combination | |
| d. Direct Application - Single Stand | c. Direct Application | |
| e. Direct Application - Multi Stand | | |
| 2. Pipe and Tube | | |
| a. Water | | Segment Addec |
| b. Oil emulsion | | Segment Addec |
| K. Alkaline Cleaning | Z. Continuous Alkaline Cleaning | |
| a. Batch | | Subdivision Added |
| b. Continuous | | |
| L. Hot Coatings | T. Hot Coatings - Galvanizing | Segments Changed |
| 1. Galvanizing, Terne & Other | a. Galvanizing | |
| 2. Fume Scrubber | b. Fume scrubber | |

TABLE II-7

## SOLID WASTE GENERATION DUE TO WATER POLLUTION CONTROL IRON AND STEEL INDUSTRY

| Subcategory | BPT (tons/yr) | | | BAT (tons/yr) | | | PSES (tons/yr) | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of Plants | Model Plant | Subcategory | No. of Plants | Model Plant | Subcategory | No. of Plants | Model Plant | Subcategory |
| A. Cokemaking | | | | | | | | | |
| 1. Iron & Steel | 31 | 1,239 | 38,409 | 28 | * | * | 8 | 1,314 | 10,512 |
| 2. Merchant | 11 | 546 | 6,006 | 9 | * | * | 8 | 292 | 2,336 |
| B. Sintering | 16 | 165,940 | 2,655,040 | 15 | * | * | 1 | 165,940 | 165,940 |
| C. Ironmaking | 43 | 119,465 | 5,136,995 | 39 | 550 | 21,450 | 2 | 120,015 | 240,030 |
| D. Steelmaking | | | | | | | | | |
| 1. BOF | | | | | | | | | |
| a. Semi-Wet | 9 | 800 | 7,200 | 8 | - | - | 0 | 800 | 0 |
| b. Wet Suppressed | 5 | 7,550 | 37,750 | 5 | 70 | 350 | 1 | 7,620 | 7,620 |
| c. Wet Open | 13 | 63,260 | 822,380 | 13 | 200 | 2,600 | 1 | 63,460 | 63,460 |
| 2. Open Hearth - Wet | 4 | 30,360 | 121,440 | 4 | 265 | 1,060 | 0 | 30,625 | 0 |
| 3. Electric Furnace | | | | | | | | | |
| a. Semi-Wet | 3 | 1,500 | 4,500 | 3 | - | - | 0 | 1,500 | 0 |
| b. Wet | 6 | 19,270 | 115,620 | 6 | 42 | 252 | 1 | 19,310 | 19,310 |
| E. Vacuum Degassing | 33 | 80 | 2,640 | 31 | 40 | 1,240 | 0 | 120 | 0 |
| F. Continuous Casting | 42 | 400 | 16,800 | 25 | 40 | 1,000 | 7 | 440 | 3,080 |
| G. Hot Forming | | | | | | | | | |
| 1. Primary | | | | | | | | | |
| a. Carbon w/Scarfer | 30 | 80,262 | 2,407,860 | 30 | - | - | 2 | 80,262(1) | 160,524 |
| b. Carbon wo/Scarfer | 30 | 20,718 | 621,540 | 29 | - | - | 2 | 20,718(1) | 41,436 |
| c. Spec. w/Scarfer | 5 | 19,738 | 98,690 | 5 | - | - | 0 | 19,738(1) | 0 |
| d. Spec. wo/Scarfer | 12 | 6,498 | 77,976 | 11 | - | - | 2 | 6,498(1) | 12,996 |
| 2. Section | | | | | | | | | |
| a. Carbon | 52 | 16,577 | 862,004 | 48 | - | - | 7 | 16,577(1) | 116,039 |
| b. Specialty | 20 | 6,578 | 131,560 | 17 | - | - | 1 | 6,578(1) | 6,578 |
| 3. Flat | | | | | | | | | |
| a. Carbon HS&S | 30 | 38,479 | 1,154,370 | 30 | - | - | 2 | 38,479(1) | 76,958 |
| b. Spec. HS&S | 7 | 4,883 | 34,181 | 7 | - | - | 0 | 4,883(1) | 0 |
| c. Carbon Plate | 11 | 16,979 | 186,769 | 11 | - | - | 1 | 16,979(1) | 16,979 |
| d. Spec. Plate | 5 | 5,342 | 26,710 | 5 | - | - | 0 | 5,342(1) | 0 |
| 4. Pipe & Tube | | | | | | | | | |
| a. Carbon | 25 | 759 | 18,975 | 25 | - | - | 1 | 759(1) | 759 |
| b. Specialty | 8 | 2,479 | 19,832 | 8 | - | - | 0 | 2,479(1) | 0 |
| H. Salt Bath Descaling | | | | | | | | | |
| 1. Oxidizing | | | | | | | | | |
| a. Batch Sheet/Plate | 5 | 380 | 1,900 | 5 | - | - | 0 | 380 | 0 |
| b. Batch Rod/Wire | 3 | 440 | 1,320 | 3 | - | - | 1 | 440 | 440 |
| c. Batch Pipe/Tube | 2 | 540 | 1,080 | 2 | - | - | 0 | 540 | 0 |
| d. Continuous | 7 | 420 | 2,940 | 7 | - | - | 1 | 420 | 420 |
| 2. Reducing | | | | | | | | | |
| a. Batch | 4 | 160 | 640 | 4 | - | - | 1 | 160 | 160 |
| b. Continuous | 2 | 60 | 120 | 2 | - | - | 0 | 60 | 0 |

TABLE II-7
SOLID WASTE GENERATION DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY
PAGE 2

| | BPT (tons/yr) | | | BAT (tons/yr) | | | PSES (tons/yr) | | |
|---|---|---|---|---|---|---|---|---|---|
| Subcategory | No. of Plants | Model Plant | Subcategory | No. of Plants | Model Plant | Subcategory | No. of Plants | Model Plant | Subcategory |
| I. Acid Pickling | | | | | | | | | |
| 1. Sulfuric | | | | | | | | | |
| a. S/S/P Neut | 23 | 74,780 | 1,719,940 | 23 | - | - | 4 | 74,780 | 299,120 |
| b. R/W/C Neut | 16 | 16,260 | 260,160 | 16 | - | - | 18 | 16,260 | 292,680 |
| c. B/B/B Neut | 15 | 22,720 | 340,800 | 15 | - | - | 3 | 22,720 | 68,160 |
| d. P/T Neut | 17 | 13,360 | 227,120 | 17 | - | - | 9 | 13,360 | 120,240 |
| e. S/S/P AU(2) | 2 | 13,440 | 26,880 | 2 | - | - | 0 | - | - |
| f. R/W/C AU(2) | 5 | 2,340 | 11,700 | 5 | - | - | 0 | - | - |
| g. B/B/B AU(2) | 0 | 4,680 | 0 | 0 | - | - | 0 | - | - |
| h. P/T AU(1) | 1 | 1,560 | 1,560 | 1 | - | - | 0 | - | - |
| 2. Hydrochloric | | | | | | | | | |
| a. S/S/P Neut | 21 | 85,280 | 1,790,880 | 21 | - | - | 3 | 85,280 | 255,840 |
| b. R/W/C Neut | 7 | 3,640 | 25,480 | 7 | - | - | 8 | 3,640 | 29,120 |
| c. P/T Neut | 2 | 3,140 | 6,280 | 2 | - | - | 1 | 3,140 | 3,140 |
| d. S/S/P AR | 4 | 41,440 | 165,760 | 4 | - | - | 0 | - | - |
| 3. Combination | | | | | | | | | |
| a. Batch S/S/P | 9 | 5,080 | 45,720 | 9 | - | - | 0 | 5,080 | 0 |
| b. Continuous S/S/P | 14 | 27,640 | 386,960 | 14 | - | - | 1 | 27,640 | 27,640 |
| c. R/W/C | 9 | 8,120 | 73,080 | 9 | - | - | 8 | 8,120 | 64,960 |
| d. B/B/B | 3 | 4,560 | 13,680 | 3 | - | - | 1 | 4,560 | 4,560 |
| e. P/T | 11 | 4,740 | 52,140 | 11 | - | - | 8 | 4,740 | 37,920 |
| J. Cold Forming | | | | | | | | | |
| 1. Cold Rolling | | | | | | | | | |
| a. Single Stand Recirc | 13 | 40 | 520 | 13 | - | - | 3 | 40 | 120 |
| b. Multi Stand Recirc | 21 | 700 | 14,700 | 21 | - | - | 3 | 700 | 2,100 |
| c. Combination | 10 | 9,300 | 93,000 | 10 | - | - | 0 | 9,300 | 0 |
| d. Single Stand DA | 9 | 340 | 3,060 | 9 | - | - | 0 | 340 | 0 |
| e. Multi Stand DA | 10 | 1,800 | 18,000 | 10 | - | - | 0 | 1,800 | 0 |
| 2. CF - Pipe & Tube | | | | | | | | | |
| a. Water | 9 | 140 | 1,260 | 9 | - | - | 2 | - | - |
| b. Oil | 19 | 420 | 7,980 | 19 | - | - | 0 | 1,320 | 0 |
| K. Alkaline Cleaning | | | | | | | | | |
| 1. Batch | 22 | 20 | 440 | 22 | - | - | 9 | - | - |
| 2. Continuous | 22 | 260 | 5,720 | 22 | - | - | 9 | - | - |
| L. Hot Coating | | | | | | | | | |
| 1. Galvanizing | | | | | | | | | |
| a. S/S/M wo/FS | 18 | 1,380 | 24,840 | 14 | - | - | 2 | 1,380 | 2,760 |
| b. S/S/M w/FS | 12 | 1,640 | 19,680 | 11 | * | * | 1 | 1,640 | 1,640 |
| c. WP/F wo/FS | 10 | 440 | 4,400 | 9 | - | - | 7 | 440 | 3,080 |
| d. WP/F w/FS | 6 | 520 | 3,120 | 6 | * | * | 7 | 520 | 3,640 |
| 2. Terne | | | | | | | | | |
| a. S/S/M wo/FS | 1 | 240 | 240 | 1 | - | - | 1 | 240 | 240 |
| b. S/S/M w/FS | 3 | 340 | 1,020 | 3 | * | * | 0 | 340 | 0 |
| 3. Other | | | | | | | | | |
| a. S/S/M wo/FS | 4 | 960 | 3,840 | 3 | - | - | 0 | 960 | 0 |
| b. S/S/M w/FS | 0 | 1,220 | 0 | 0 | * | * | 0 | 1,220 | 0 |
| c. WP/F wo/FS | 2 | 80 | 160 | 2 | - | - | 4 | 80 | 320 |
| d. WP/F w/FS | 0 | 100 | 0 | 0 | * | * | 0 | 100 | 0 |
| TOTALS | | | 19,963,367 | | | 27,952 | | | 2,162,857 |

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(1): Based upon current practices of POTW discharges.
(2): Ferrous sulfate crystal disposal
- : No limitations/standards are being promulgated for this subdivision.
* : Sludge generation at this level is minimal and is included in the BPT sludge generation load.

## TABLE II-8

## ENERGY REQUIREMENTS DUE TO WATER POLLUTION CONTROL IRON AND STEEL INDUSTRY

| | BPT (kwh) | | | BAT (kwh) | | | PSES (kwh) | | |
|---|---|---|---|---|---|---|---|---|---|
| Subcategory | No. of Plants | Model | Subcategory | No. of Plants | Model | Subcategory | No. of Plants | Model | Subcategory |
| A. Cokemaking | | | | | | | | | |
| 1. Iron & Steel | 31 | 1,668,000 | 51,708,000 | 28 | 1,416,000 | 39,648,000 | 8 | 620,000 | 4,960,000 |
| 2. Merchant | 11 | 804,000 | 8,844,000 | 9 | 588,000 | 5,292,000 | 8 | 216,000 | 1,728,000 |
| B. Sintering | 16 | 2,512,000 | 40,192,000 | 15 | 152,000 | 2,280,000 | 1 | 2,664,000 | 2,664,000 |
| C. Ironmaking | 43 | 9,768,000 | 420,024,000 | 39 | 340,000 | 13,260,000 | 2 | 10,064,000 | 20,128,000 |
| D. Steelmaking | | | | | | | | | |
| 1. BOF | | | | | | | | | |
| a. Semi-Wet | 9 | 44,000 | 396,000 | 8 | - | - | 0 | 44,000 | 0 |
| b. Wet Suppressed | 5 | 1,048,000 | 5,240,000 | 5 | 76,000 | 380,000 | 1 | 1,124,000 | 1,124,000 |
| c. Wet Open | 13 | 2,904,000 | 37,752,000 | 13 | 160,000 | 2,080,000 | 1 | 3,064,000 | 3,064,000 |
| 2. Open Hearth - Wet | 4 | 1,696,000 | 6,784,000 | 4 | 168,000 | 672,000 | 0 | 1,864,000 | 0 |
| 3. Electric Furnace | | | | | | | | | |
| a. Semi-Wet | 3 | 28,000 | 84,000 | 3 | - | - | 0 | 28,000 | 0 |
| b. Wet | 6 | 776,000 | 4,656,000 | 6 | 80,000 | 480,000 | 1 | 856,000 | 856,000 |
| E. Vacuum Degassing | 33 | 1,044,000 | 34,452,000 | 31 | 48,000 | 1,488,000 | 0 | 1,052,000 | 0 |
| F. Continuous Casting | 42 | 2,588,000 | 108,696,000 | 25 | 48,000 | 1,200,000 | 7 | 2,600,000 | 18,200,000 |
| G. Hot Forming | | | | | | | | | |
| 1. Primary | | | | | | | | | |
| a. Carbon w/Scarfer | 30 | 732,000 | 21,960,000 | 30 | - | - | 2 | 732,000 (1) | 1,464,000 |
| b. Carbon wo/Scarfer | 30 | 1,140,000 | 34,200,000 | 29 | - | - | 2 | 1,140,000(1) | 2,280,000 |
| c. Spec. w/Scarfer | 5 | 408,000 | 2,040,000 | 5 | - | - | 0 | 408,000(1) | 0 |
| d. Spec. wo/Scarfer | 12 | 548,000 | 6,576,000 | 11 | - | - | 2 | 548,000(1) | 1,096,000 |
| 2. Section | | | | | | | | | |
| a. Carbon | 52 | 1,000,000 | 52,000,000 | 48 | - | - | 7 | 1,000,000(1) | 7,000,000 |
| b. Specialty | 20 | 452,000 | 9,040,000 | 17 | - | - | 1 | 452,000(1) | 452,000 |
| 3. Flat | | | | | | | | | |
| a. Carbon HS&S | 30 | 1,304,000 | 39,120,000 | 30 | - | - | 2 | 1,304,000(1) | 2,608,000 |
| b. Spec. HS&S | 7 | 568,000 | 3,976,000 | 7 | - | - | 0 | 568,000(1) | 0 |
| c. Carbon Plate | 11 | 616,000 | 6,776,000 | 11 | - | - | 1 | 616,000(1) | 616,000 |
| d. Spec. Plate | 5 | 240,000 | 1,200,000 | 5 | - | - | 0 | 240,000(1) | 0 |

TABLE II-8
ENERGY REQUIREMENTS DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY
PAGE 2

| Subcategory | BPT (kwh) No. of Plants | BPT (kwh) Model | BPT (kwh) Subcategory | BAT (kwh) No. of Plants | BAT (kwh) Model | BAT (kwh) Subcategory | PSES (kwh) No. of Plants | PSES (kwh) Model | PSES (kwh) Subcategory |
|---|---|---|---|---|---|---|---|---|---|
| 4. Pipe & Tube | | | | | | | | | |
| a. Carbon | 25 | 428,000 | 10,700,000 | 25 | - | - | 1 | 428,000(1) | 428,000 |
| b. Specialty | 8 | 768,000 | 6,144,000 | 8 | - | - | 0 | 768,000(1) | 0 |
| H. Salt Bath Descaling | | | | | | | | | |
| 1. Oxidizing | | | | | | | | | |
| a. Batch Sheet/Plate | 5 | 188,000 | 940,000 | 5 | - | - | 0 | 188,000 | 0 |
| b. Batch Rod/Wire | 3 | 196,000 | 588,000 | 3 | - | - | 1 | 196,000 | 196,000 |
| c. Batch Pipe/Tube | 2 | 200,000 | 400,000 | 2 | - | - | 0 | 200,000 | 0 |
| d. Continuous | 7 | 200,000 | 1,400,000 | 7 | - | - | 1 | 200,000 | 200,000 |
| 2. Reducing | | | | | | | | | |
| a. Batch | 4 | 76,000 | 304,000 | 4 | - | - | 1 | 76,000 | 76,000 |
| b. Continuous | 2 | 76,000 | 152,000 | 2 | - | - | 0 | 76,000 | 0 |
| I. Acid Pickling | | | | | | | | | |
| 1. Sulfuric | | | | | | | | | |
| a. S/S/P Neut | 23 | 860,000 | 19,780,000 | 23 | - | - | 4 | 860,000 | 3,440,000 |
| b. R/W/C Neut | 16 | 448,000 | 7,168,000 | 16 | - | - | 18 | 448,000 | 8,064,000 |
| c. B/B/B Neut | 15 | 424,000 | 6,360,000 | 15 | - | - | 3 | 424,000 | 1,272,000 |
| d. P/T Neut | 17 | 404,000 | 6,868,000 | 17 | - | - | 9 | 404,000 | 3,636,000 |
| e. S/S/P AU | 2 | 2,148,000 | 4,296,000 | 2 | - | - | 0 | - | - |
| f. R/W/C AU | 5 | 396,000 | 1,980,000 | 5 | - | - | 0 | - | - |
| g. B/B/B AU | 0 | 744,000 | 0 | 0 | - | - | 0 | - | - |
| h. P/T AU | 1 | 232,000 | 232,000 | 1 | - | - | 0 | - | - |
| 2. Hydrochloric | | | | | | | | | |
| a. S/S/P Neut | 21 | 7,040,000 | 147,840,000 | 21 | - | - | 3 | 7,040,000 | 21,120,000 |
| b. R/W/C Neut | 7 | 332,000 | 2,324,000 | 7 | - | - | 8 | 332,000 | 2,656,000 |
| c. P/T Neut | 2 | 316,000 | 632,000 | 2 | - | - | 1 | 316,000 | 316,000 |
| d. S/S/P AR | 4 | 11,716,000 | 46,864,000 | 4 | - | - | 0 | - | - |
| 3. Combination | | | | | | | | | |
| a. Batch S/S/P | 9 | 332,000 | 2,988,000 | 9 | - | - | 0 | 332,000 | 0 |
| b. Continuous S/S/P | 14 | 1,112,000 | 15,568,000 | 14 | - | - | 1 | 1,112,000 | 1,112,000 |
| c. R/W/C | 9 | 388,000 | 3,492,000 | 9 | - | - | 8 | 388,000 | 3,104,000 |
| d. B/B/B | 3 | 316,000 | 948,000 | 3 | - | - | 1 | 316,000 | 316,000 |
| e. P/T | 11 | 324,000 | 3,564,000 | 11 | - | - | 8 | 324,000 | 2,592,000 |

TABLE II-8
ENERGY REQUIREMENTS DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY
PAGE 3

| Subcategory | BPT (kwh) No. of Plants | BPT (kwh) Model | BPT (kwh) Subcategory | BAT (kwh) No. of Plants | BAT (kwh) Model | BAT (kwh) Subcategory | PSES (kwh) No. of Plants | PSES (kwh) Model | PSES (kwh) Subcategory |
|---|---|---|---|---|---|---|---|---|---|
| J. Cold Forming | | | | | | | | | |
| 1. Cold Rolling | | | | | | | | | |
| a. Single Stand Recirc | 13 | 120,000 | 1,560,000 | 13 | - | - | 3 | 120,000 | 360,000 |
| b. Multi Stand Recirc | 21 | 220,000 | 4,620,000 | 21 | - | - | 3 | 220,000 | 660,000 |
| c. Combination | 10 | 1,444,000 | 14,440,000 | 10 | - | - | 0 | 1,444,000 | 0 |
| d. Single Stand DA | 9 | 292,000 | 2,628,000 | 9 | - | - | 0 | 292,000 | 0 |
| e. Multi Stand DA | 10 | 1,104,000 | 11,040,000 | 10 | - | - | 0 | 1,104,000 | 0 |
| 2. CF - Pipe & Tube | | | | | | | | | |
| a. Water | 9 | 8,000 | 72,000 | 9 | - | - | 2 | - | - |
| b. Oil | 19 | 8,000 | 152,000 | 1 | - | - | 0 | 8,000 | 0 |
| K. Alkaline Cleaning | | | | | | | | | |
| 1. Batch | 22 | 60,000 | 1,320,000 | 22 | - | - | 9 | - | - |
| 2. Continuous | 22 | 96,000 | 2,112,000 | 22 | - | - | 9 | - | - |
| L. Hot Coating | | | | | | | | | |
| 1. Galvanizing | | | | | | | | | |
| a. S/S/M wo/FS | 18 | 352,000 | 6,336,000 | 14 | - | - | 2 | 362,000 | 724,000 |
| b. S/S/M w/FS | 12 | 452,000 | 5,424,000 | 11 | 32,000 | 352,000 | 1 | 484,000 | 484,000 |
| c. WP/F wo/FS | 10 | 244,000 | 2,440,000 | 9 | - | - | 7 | 244,000 | 1,708,000 |
| d. WP/F w/FS | 6 | 348,000 | 2,088,000 | 6 | 32,000 | 192,000 | 7 | 380,000 | 2,660,000 |
| 2. Terne | | | | | | | | | |
| a. S/S/M wo/FS | 1 | 192,000 | 192,000 | 1 | - | - | 1 | 192,000 | 192,000 |
| b. S/S/M w/FS | 3 | 248,000 | 744,000 | 3 | 24,000 | 72,000 | 0 | 272,000 | 0 |
| 3. Other | | | | | | | | | |
| a. S/S/M wo/FS | 4 | 300,000 | 1,200,000 | 3 | - | - | 0 | 300,000 | 0 |
| b. S/S/M w/FS | 0 | 332,000 | 0 | 0 | 24,000 | 0 | 0 | 60,000 | 0 |
| c. WP/F wo/FS | 2 | 60,000 | 120,000 | 2 | - | - | 4 | 136,000 | 544,000 |
| d. WP/F w/FS | 0 | 136,000 | 0 | 0 | 24,000 | 0 | 0 | 160,000 | 0 |
| TOTALS | | | 1,243,736,000 | | | 67,396,000 | | | 124,100,000 |

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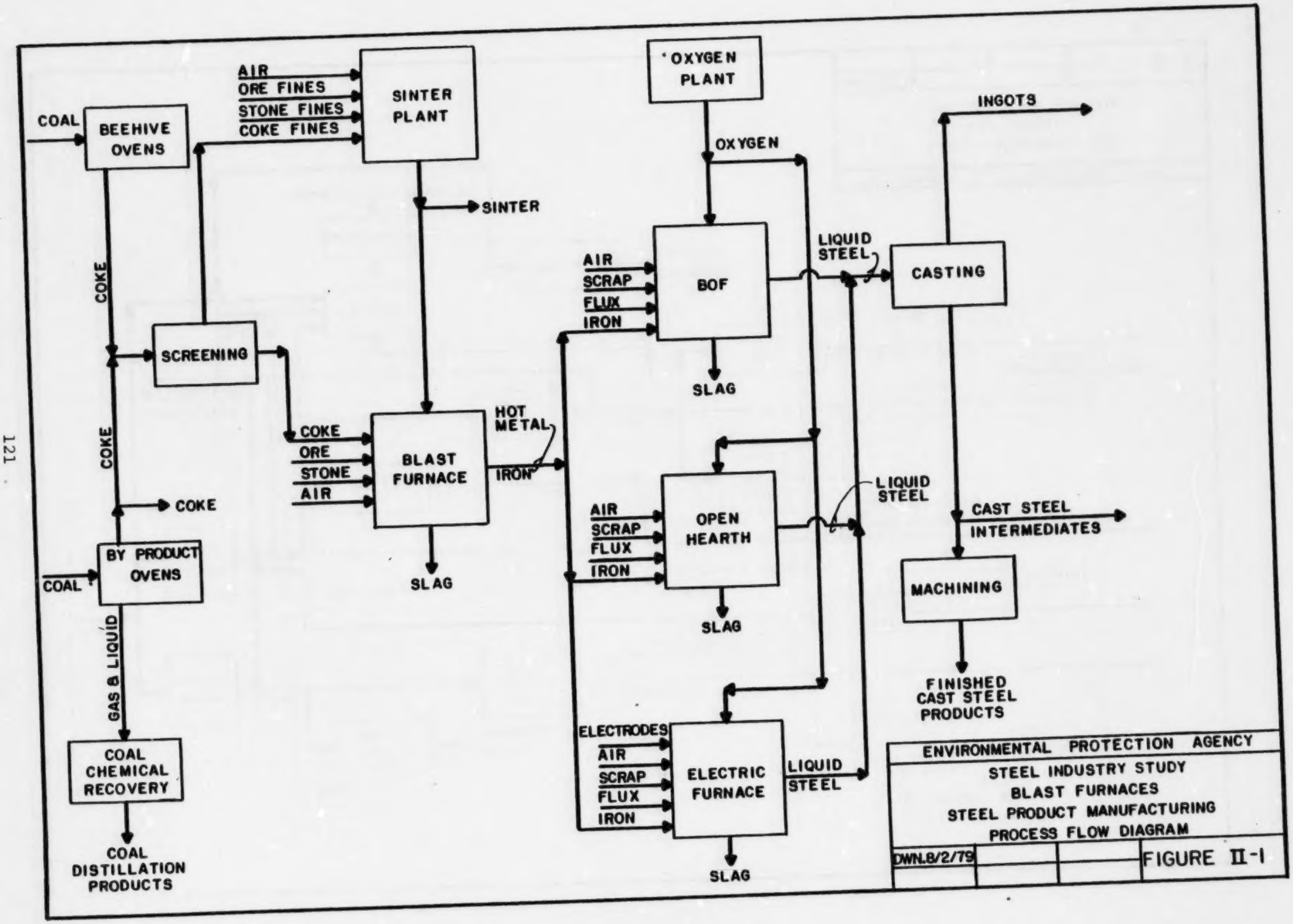
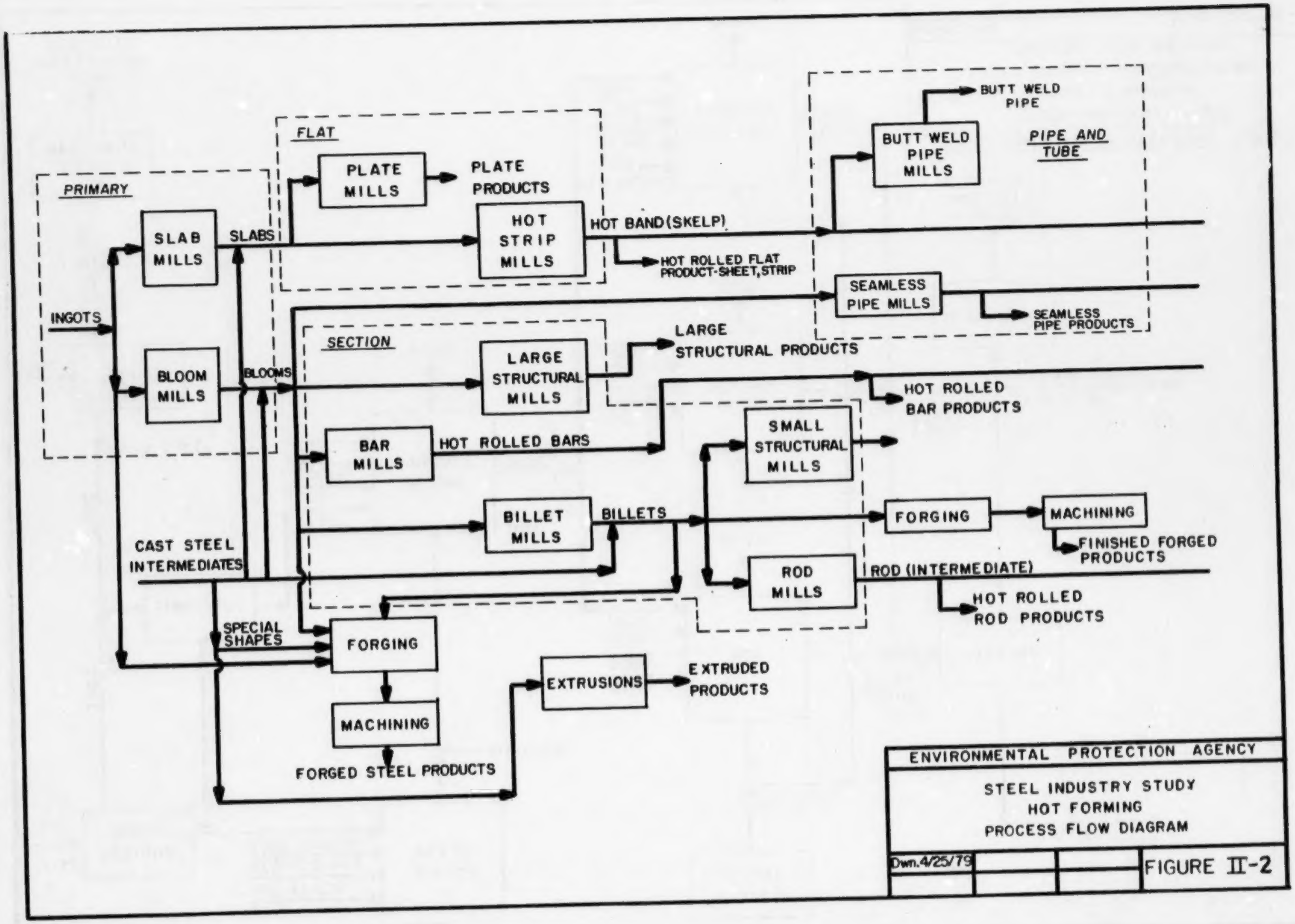
(1) Based upon current treatment practices.



ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACES
STEEL PRODUCT MANUFACTURING
PROCESS FLOW DIAGRAM
DWN.8/2/79
FIGURE II-1

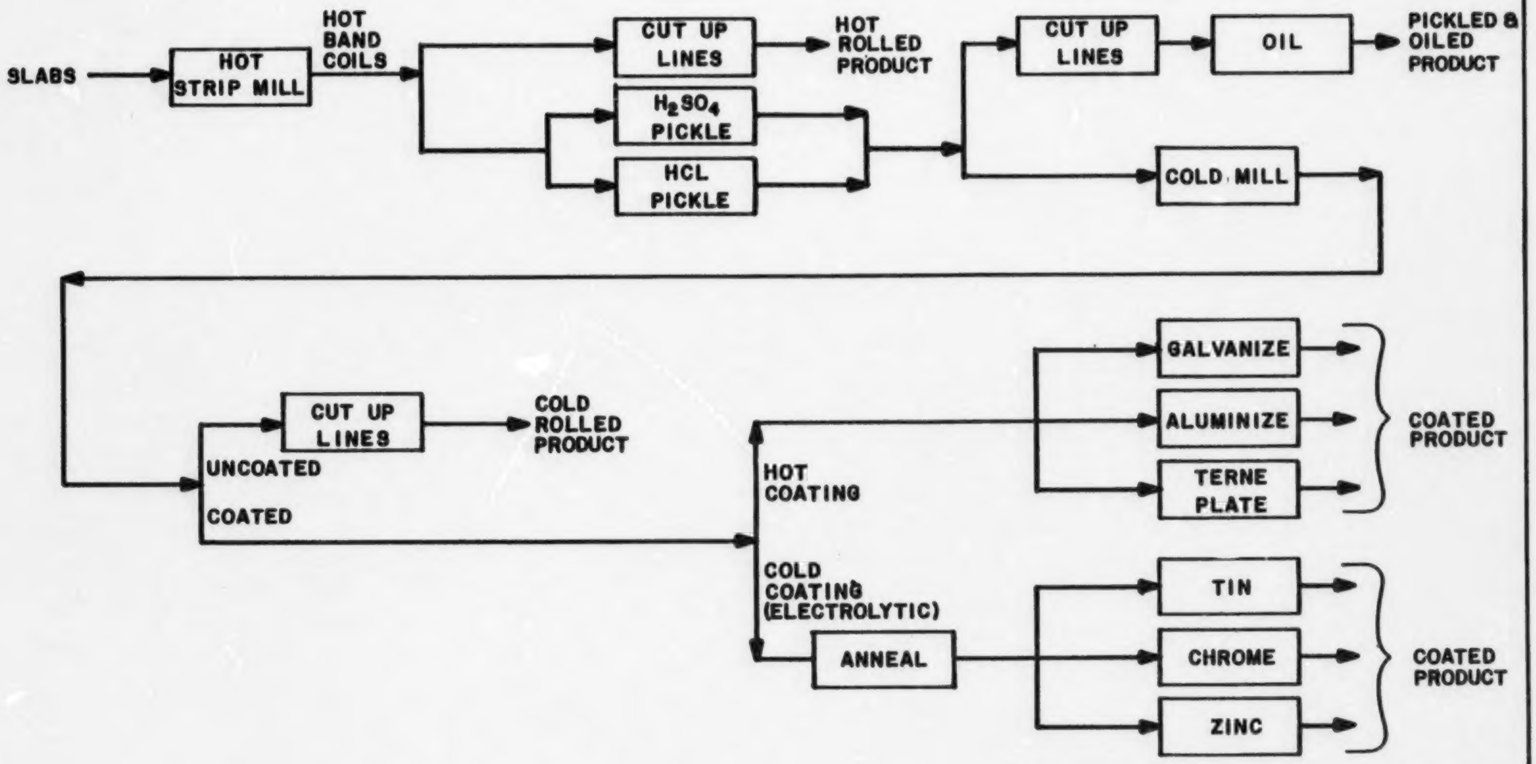


ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
HOT FORMING
PROCESS FLOW DIAGRAM

Dwn. 4/25/79

FIGURE II-2



ENVIRONMENTAL PRODUCTION AGENCY

STEEL INDUSTRY STUDY
FLAT PRODUCTS GENERAL
PROCESS FLOW DIAGRAM

Dwn. 7/15/80

FIGURE II-3

## SECTION III

## REMAND ISSUES ON PRIOR REGULATIONS

### Introduction

After reviewing the 1974 (Phase I) and 1976 (Phase II) regulations for the steel industry, the Court of Appeals ordered EPA to reconsider several matters. This section provides a summary of the Agency's evaluation and response to the "remand issues". The respective subcategory reports provide the Agency's responses to subcategory specific remand issues.

1. Site-Specific Costs

In its challenge to the Phase I regulation, the industry asserted that EPA's cost estimates did not include allowances for "site-specific" costs. The industry submitted no data showing the magnitude of site-specific costs. The Agency responded that it included all costs which could be reasonably estimated and that it believed its estimates were sufficiently generous to cover site-specific costs. On this basis, the court rejected this challenge to the regulation. American Iron and Steel Institute v. EPA, 526 F.2d 1027 (3d Cir. 1975), modified in part, 560 F.2d 589 (3d Cir. 1977), cert. den. 98 S. Ct 1467 (1978).

In the Phase II proceedings, however, evidence of the possible magnitude of "site-specific" cost was presented.[4] On this basis, the court ordered EPA to reevaluate its cost estimates in light of site-specific costs. In particular, the court ordered EPA to include these costs, or analyze the generosity of its estimates by comparing model cost estimates with actual reported costs, or explain why such an analysis could not be done.

In response to the court's decisions, the Agency reevaluated its cost estimates for Phase I and Phase II operations. First, the Agency included in its estimates many "site-specific" costs which were not included in prior estimates.[5] In the Agency's view, it has included all "site-specific costs" that can be reasonably and accurately estimated without detailed site-specific studies. The

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[4] This evidence consisted of the plant-by-plant compliance estimates for facilities located in the Mahoning Valley region of Eastern Ohio.

[5] These newly added cost items include: land acquisition costs, site clearance costs, utility connections, and miscellaneous utility requirements. (Reference is made to Section VII)

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remaining "site-specific" costs not included are so highly variable and inherently site-specific that reasonably accurate estimates would require an evaluation of the factors as they apply to each operation. It should be noted that studies commissioned by AISI, itself, also exclude site-specific costs. For example, in Arthur D. Little's Steel and the Environment - A Cost Impact Analysis, site-specific costs and land acquisition costs were excluded "...because detailed site-specific studies would be required."

Second, the Agency included in its cost estimates allowances for unforeseen expenses. The model-based cost estimates for each subcategory include a 15% contingency fee.[6]

Third, the Agency has based its cost estimates on many conservative assumptions. For instance, in most subcategories, the Agency's cost estimates are based upon individual treatment of wastewaters from all operations within each subcategory at each plant site. In fact, however, the industry has installed and will continue to install less costly "central treatment" systems to treat combined waste streams from several subcategories. Additionally, EPA's model based estimates reflect off the shelf parts and costs for "outside" engineering and construction services.[7] In fact, however, the industry often uses "in-house" engineering and construction resources, and improves wastewater quality by "gerrymandering" existing treatment systems and upgrading operating and maintenance practices. The Agency's cost estimates reflect treatment in place as of 1976 and treatment to have been installed by January 1978 [based upon survey (DCP) responses]; and facilities in place as of July 1, 1981. The Agency updated the status of the industry from January 1978 to July 1981 from personal knowledge of Agency experts on the industry; NPDES records; and, in some cases, telephone surveys.

Fourth, EPA has compared its model-based cost estimates to the costs reported by the industry. This comparison shows that the Agency's estimates are sufficiently generous to reflect all costs, including "site-specific" costs. Model-based estimates cannot be expected to precisely reflect the costs incurred or to be incurred by each individual plant. Variations of greater than ±50% would not be considered outside normal confidence levels. For example, in Steel and the Environment - A Cost Impact Analysis, a study by Arthur D. Little, Inc., commissioned by the AISI, the authors indicated that cost estimates were within ± 50%

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[6] This contingency fee was also included in previous cost estimates.
[7] The model estimates include 15% for engineering services.

for individual process steps and ± 85% for individual plants.[8] Often, variations from model estimates cannot be explained. The validity of model estimates, therefore, should be judged by the ability to depict actual costs for subcategories of the industry for the industry, as a whole where several treatment systems are evaluated collectively.

The Agency's comparison of model-based cost estimates and costs reported by industry involved two complimentary analyses. First, the Agency compared actual reported treatment costs (including all site-specific costs) to the model cost estimates for the treatment components in place at the reporting plants. These comparisions include costs for all plants for which sufficiently detailed cost information were provided, taking into account the level of treatment in place. To generate valid comparisons, the model cost estimate was scaled to the actual production of the reporting plant by the application of the accepted engineering "six-tenths" factor. The Agency scaled production of the model to actual production of the reporting plant because, in its view, this produces the most reliable cost comparison. Another possible method of comparison would be to scale the flow of the model to the actual flow of the reporting plant. This method of scaling would overstate treatment costs because costs are highly dependent on flow volume (higher flows require larger and more costly treatment systems) and many plants in the industry use and discharge more water than necessary. Also, flow data are not available for all plants while production data are available for most operations and plants in the industry. This comparative analysis is summarized below for those subcategories where the Agency was able to obtain reliable subcategory-specific costs from the industry.

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[8] See pages B-64 and B-65 of Steel and the Environment - A Cost Impact Analysis which AISI submitted to EPA during the Phase II rulemaking.

Treatment In Place v. Model Estimates for Same Treatment

| Subpart (process) | Actual Cost ($\$x10^{-6}$) | EPA Model Estimate ($\$x10^{-6}$) | Actual as % of Model |
|---|---|---|---|
| A. Cokemaking | 56.05 | 54.24 | 103 |
| B. Sintering | 6.43 | 10.53 | 61 |
| C. Ironmaking | 110.12 | 123.39 | 89 |
| D. Steelmaking | 37.61 | 42.32 | 89 |
| E. Vacuum Degassing | 2.19 | 2.32 | 94 |
| F. Continuous Casting | 29.38 | 23.00 | 128 |
| G. Hot Forming | 78.87 | 107.46 | 73 |
| Total | 320.65 | 363.26 | 88.3 |

This summary shows that actual reported costs for the industry (including all site-specific costs) represent about 88% of the model estimates for the same treatment components. On this basis, the Agency concludes that its model estimates are sufficiently generous to reflect site-specific costs.

In the second comparison of reported costs and model estimates, the Agency compared the reported costs (including all site-specific costs) of plants meeting BPT (or BAT) to the model estimates for the BPT (or BAT) treatment system. This methodology, which the Agency presented in its brief in the Phase II proceedings, demonstrates that the effluent limitations and standards can be achieved with treatment systems comparable to the Agency's treatment models at costs comparable to the Agency's estimated costs. This comparison, which also is based upon scaling of production by the "six-tenths factor," is summarized below:

## SUMMARY

### Complying Plant Costs v. Model Compliance Estimates

| Subcategory (process) | Actual Costs ($\$ \times 10^{-6}$) | Model Estimate ($\$ \times 10^{-6}$) | Actual as % of Model |
|---|---|---|---|
| A. Cokemaking | 40.71 | 40.60 | 100 |
| B. Sintering | 5.92 | 6.35 | 93 |
| C. Ironmaking | 33.16 | 51.97 | 64 |
| D. Steelmaking | 37.61 | 47.74 | 79 |
| E. Vacuum Degassing | 2.08 | 2.48 | 84 |
| F. Continuous Casting | 19.36 | 18.61 | 104 |
| G. Hot Forming | 77.64 | 106.22 | 73 |
| Total | 216.48 | 273.97 | 79.0 |

Again, this summary shows that total reported costs (including all site-specific costs) for plants meeting required effluent levels is about 79% of model estimates. On this basis, EPA likewise concludes that its model-based cost estimates are sufficiently generous to reflect site-specific costs.

As noted in the subcategory reports for many of the Phase II operations, central treatment of wastewaters from finishing operations is common in the steel industry. The cost data reported by the industry for these central treatment systems are often not directly usable for the purpose of verifying the Agency's cost estimates for individual subcategory treatment systems. As noted earlier, the Agency considered co-treatment of wastewaters at plants within subcateogries, but did not consider co-treatment or central treatment across subcategories in developing cost estimates. To determine the impact of the extensive amount of central treatment in the industry on the Agency's ability to accurately estimate costs, the Agency compared actual industry central treatment costs with the Agency's model based cost estimates for the respective subcategories included in the industry's central treatment systems. This comparison is shown below.

## ACTUAL COSTS vs. EPA CO-TREATMENT ESTIMATES

| PLANT | SUBCATEGORIES | ACTUAL COST | MODEL COST |
|---|---|---|---|
| 0112B | Hot Forming (Primary, Section) | $ 2,578,000 | $ 5,133,000 |
| 0112H | Pickling (HCl, Combination) | 746,000 | 882,000 |
| 0432K | Pickling, Scale Removal, Alkaline Cleaning | 9,350 | 1,374,000 |
| 0796 & 0796A | Vacuum Degassing, Continuous Casting, Hot Forming (Primary, Section, Pipe and Tube), Pickling ($H_2SO_4$), Cold Rolling | 16,770,000 | 15,793,000 |
| 0868A | Cold Rolling, Pickling (HCl, $H_2SO_4$), Hot Coating, Alkaline Cleaning | 4,857,000 | 5,235,000 |
| 0868A | Hot Forming (Primary, Section) | 303,000 | 2,317,000 |
| 0176 | Hot Forming (Primary and Section), Cold Rolling (Direct Application), Cold Worked Pipe and Tube, Pickling (HCl, $H_2SO_4$, Combination), Scale Removal, Alkaline Cleaning | 3,060,000 | 5,587,000 |
| 0460A | Hot Forming (Primary, Section) | 340,000 | 1,017,000 |
| 0612 | Hot Coating (Galvanizing), Pickling (HCl) | 1,645,000 | 3,914,000 |
| 0728 | Hot Forming (Pipe and Tube), Pickling ($H_2SO_4$), Hot Coating (Galvanizing) | 198,000 | 437,000 |
| | TOTAL | 31,432,000 | 41,689,000 |

These data clearly indicate that in total, the Agency's estimates for separate subcategory-specific treatment systems far exceed those costs reported by the industry for central treatment. Of particular interest are the data reported for plants 0796-0796A, a central treatment facility that achieves the BAT limitations for the operations included in the central treatment facility. The Agency's estimate is within six percent of the actual cost reported by the company. This system includes several miles of retrofitted wastewater collection and distribution piping not likely to be included in most central treatment systems. Based upon the above, the Agency concludes that its separate subcategory-specific cost estimates for the Phase II operations are sufficiently generous to include those site specific costs likely to be incurred for most central treatment facilities, and may be overly generous in depicting potential costs for steel finishing operations as a whole.

Another approach to judging the sufficiency of the Agency's model estimates, to account for "site-specific" costs, is to determine the adequacy of the Agency's cost estimates for several steel mills located in the Mahoning Valley of Ohio. Studies of these plants completed in 1977 included cost estimates for compliance with the previously promulgated and proposed Phase I and Phase II requirements. These eight plants were among the oldest in the country. Estimated compliance costs were furnished by the owners of the plants, based upon actual site inspections and engineering studies, and were verfied by the Agency's engineering contractor.

The tables summarizing those studies, which were part of the record of the Phase II rulemaking, are reproduced as Tables III-1 through III-3. Table III-1 summarizes the estimated compliance costs for the Youngstown Sheet and Tube Corporation Brier Hill, Campbell, and Struthers Works. Column #1 shows YS&T's estimate of BAT compliance costs, totaling $54,106,000, including all site-specific costs.[9] The Agency's contractor estimates, $51,214,000, is shown in Column #2. In Columns #3 and #4, the Agency's contractor scaled the flow and production of the BAT cost model to the actual flow and production of the mills involved, yielding cost estimates of $53,218,000 and $60,568,000, respectively. By either method of scaling, the Agency's estimate is representative of YS&T's estimate which includes site-specific costs. In fact, the estimate scaled by production (the method now used for all cost estimates) more than accounted for the significant "site-specific" costs the industry claimed the model could not reflect.[10]

Analyses of estimated compliance costs for facilities owned by United States Steel Corporation and Republic Steel Corporation yield similar results. Table III-2 shows that U.S. Steel's $33,110,000 BAT estimate (including $13,145,000 site costs) for its McDonald Mills and Ohio Works plants is within 4% of EPA's model estimate of $34,389,000 (scaled by production). Similarly, Table III-3 shows that Republic Steel's BPT estimate of $70,099,000 (including $15,590,000 site costs) for its Warren, Youngstown, and Niles plants is within 4% of the Agency's model estimated cost of $72,640,000 for physical/chemical treatment (scaled by production) and within 5% of the Agency's model estimate of $73,486,000 for biological treatment (scaled by production).

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[9] Column #5 reflects the judgment of the Agency's contractor that YS&T's $54,106,000 estimate (Column #1) included "site-specific" costs of $18,176,000.

[10] Columns #6 and #7 add site-specific costs to model estimates scaled by flow and production, yielding $71,394,000 and $78,744,000, respectively. If accurate estimation required addition of "site-specific" costs to model estimates, as industry claimed, then YS&T's compliance costs would be overstated by $17,288,000 (scaled by flow) or $24,638,000 (scaled by production).

As a final comparison, the Agency has compared its model Cost[11] estimate for a blast furnace wastewater treatment facility against that prepared by an engineering company as comissioned by one of its clients. This company costs the BAT-2 system (as identified in the 1979 draft development document) for blast furnaces and supplied its costs estimate to the Agency in its comments to the October 1979 draft development document. The company's cost and flow basis is compared below to the estimate made by the Agency. Both estimates are based upon the same model size ironmaking operation.

| | EPA Estimate | Company Estimate |
|---|---|---|
| Flow | 50 gal/ton | 100 gal/ton |
| Capital | $2.49 million | $3.94 million |

If both estimates are costed on the same flow basis (100 gal/ton) the costs are as follows:

| EPA Estimate | Company Estimate |
|---|---|
| $3.78 million | $3.94 million |

These data show that the Agency's estimate is within 4.1% of the estimate made by the engineering firm. This comparison further substantiates the reasonableness and accuracy of the Agency's cost models and costing methodology.

In summary, EPA has thoroughly reevaluated its model cost estimates in light of "site-specific" costs. It has added additional site costs to the models (see Section VII); included contingency fees in the models; used conservative cost assumptions; compared reported costs for treatment in place to model estimates for similar treatment; compared reported costs for compliance and model estimates for compliance; and, compared plant-by-plant compliance estimates with model-based cost estimates. Based upon the above, the Agency concludes that its cost estimates are sufficiently generous to reflect "site-specific" costs and other compliance costs likely to be incurred by the industry.

### 2. The Impact of Plant Age on the Cost or Feasibility of Retrofitting Control Facilities

The industry challenged both the 1974 and 1976 regulations on the basis that the Agency had failed to adequately consider the impact of plant age. In the Phase I decision, the Court held that while the Agency had adequately considered the impact of age on wastewater characteristics and treatability, it had failed to adequately consider the impact of age on the "cost or feasibility of retrofitting" controls.

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[11] Volume 3, Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category; the Agency 440/1-79/024a, October 1979.

In the Phase II proceedings, the Agency strenuously argued that plant age was not a meaningful criteria in the steel industry because plants are continually rebuilt and modernized. In response to this argument, the Court stated:

"Were we writing on a clean slate, we might find this argument convincing. But since the facts in this case cannot be properly distinguished from the facts in the earlier case we must reject EPA's contention ... We note, however, that we have not dismissed the EPA's resolution of the retrofit question on the merits. We merely require that the Agency reexamine the relevance of age specifically as it bears on retrofit." 568 F.2d at 299-300.

In light of these decisions, the Agency has throughly examined the impact of plant "age" on the "cost or feasibility" of retrofitting controls. First, in the basic Data Collection Portfolio (DCP) sent to owners or operators of all "steelmaking" operations and about 85% of "forming and finishing" operations, the Agency solicited information on the "age" of plants (including the first year of on-site production and the dates of major rebuilds and modernizations); and, the "age" of treatment facilities in place. Next, the Agency sent Detailed Data Collection Portfolios (D-DCPs) for a selected number of plants, asking owners of these plants, among other things, for a detailed report of the costs of treatment in place and the portion of those costs attributable to "retrofitting" controls. Finally, the Agency and its engineering consultant evaluated these data to determine whether plant "age" affected the "cost or feasibility of retrofitting" and, if so, whether altered subcategorization or relaxed requirements for "older" plants are warranted.

The Agency's evaluation of all available data confirms its earlier conclusion that plant "age" does not significantly affect the "cost or feasibility of retrofitting" pollution controls to existing production facilities in the steel industry. In the first place, plant "age" is not a particularly meaningful criteria in the industry. "Age" is extremely difficult to define. Judging from the first year of on-site production, the industry, as a whole, is "old." But, production facilities are continually rebuilt and modernized, some on periodic "campaign" schedules. Moreover, "campaign" schedules for operations in different subcategories, or even for operations within the same process (e.g., coke batteries) are different. Complicating this further is the fact that integrated mills contain many processes of different "ages" with different dates of first on-site production and different rebuild schedules.

Therefore, the year of first on-site production does not represent the true plant "age." For instance, at the "oldest" (1901) cokemaking facility (based upon first year of production), the "oldest" active battery dates from 1968. At several "old" plants (based upon first year of production), the "oldest" active batteries range between 1953 and 1973 and the "newest" active batteries date between 1967 and 1980.

The "age" of coke plants, therefore, changes dramatically with the criteria for determining "age." Based upon the "oldest" active battery, 7.4% of the plants date from 1920 or before; 5.9% date between 1921- 1940; 65.5% date between 1941-1960; and 20.8% date between 1961 and the present. Based on "newest" active battery, 4.4% of the plants date from 1920 or before, 40.2% date between 1941-1960, and the "age" of most (55.2%) of the plants is between 1960 and the present. Depending on the criteria selected, the age of a particular cokemaking plant, or the cokemaking industry as a whole, can vary significantly.

In the ironmaking subcategory, the date of first on-site production ranges between 1883 and 1974. However, most blast furnaces undergo major rebuilds every 9 or 10 years. Therefore, the age when determined by the last year of major rebuild would be significantly less than that based upon the first year of production.

Among most of the other subcategories, the situation is similar. Table III-4 summarizes, by subcategory, the "age" of plants in the steel industry. In each case, the "age" of plants is difficult to define because production facilities are periodically rebuilt and modernized. In many of the remaining subcategories and subdivisions, such as electric arc furnaces, "age" is not relevant because all plants are of essentially the same vintage.

Modernization of production facilities provides an impetus for construction or modernization of treatment facilities. Thus, the Agency concluded that because of the continual rebuilding and modernization of production facilities, plant "age" is not a meaningful factor in the steel industry. This conclusion is supported by studies commissioned by the industry. For example, in Steel and the Environment - A Cost Impact Analysis, which AISI submitted to EPA in its comments on the 1976 rulemaking, Arthur D. Little, Inc. concluded (at page 484) that:

"In the iron and steel industry it is difficult to define the age of a plant because many of the unit operations were installed at different times and also are periodically rebuilt on different schedules. Thus, by definition, the age of steel facilities should offer only limited benefits as a means of categorizing plants for purposes of standard setting or impact analysis."

Despite the difficulty of defining plant "age," the Agency did not terminate its analysis of the impact of "age" on the "cost or feasibility" of retrofitting controls. On the contrary, the Agency selected determinants of "age" and then analyzed the impact on the "cost or feasibility" of retrofitting.

With regard to the "feasibility" of retrofitting, the evidence is conclusive: Plant "age" does not affect the "ease" or "feasibility" of retrofitting pollution controls. Table III-5 shows that, in all subcategories, some of the "oldest" facilities (based on first year of on-site production) have among the "newest" and most efficient wastewater treatment systems. The characteristics and treatability of wastewaters from plants of all ages within each subcategory are similar. Moreover, the Agency found that treatment systems applied to wastewaters within each subcategory produced similar effluent loads, and that the same effluent limitations can be met regardless of the age of the plant. Among coke plants, for example, the oldest by-product plant (0024B) was retrofitted with water pollution control facilities as recently as 1977. Moreover, Plant 0868A, which is one of the oldest coke plants (first year of production in 1912), retrofitted pollution control facilities. This treatment facility produces an effluent which is among the best observed in the industry. In fact, the Agency has used this treatment facility as a model and has established the BAT limitations based upon the performance of this plant. Clearly, age has no affect on the feasibility of retrofitting pollution control equipment. The Agency did find, however, that the "ease" or "feasibility" of retrofitting and, to some extent, the cost of retrofitting one of its model treatment technologies (cascade rinse systems for acid pickling and hot coating operations) is significantly different for new sources vs. existing sources of any age. Accordingly, the Agency selected this technology as the basis for new source performance standards and pretreatment standards for new sources and did not use this technology to establish limitations and standards for existing sources. The factors considered by the Agency in making this determination are set out in the Acid Pickling subcategory report.

With regard to the cost of retrofitting, the impact of plant "age" is more difficult to ascertain. Costs attributable to retrofitting pollution control facilities were reported for only 15% of the plants for which responses to Agency questionnaires were received. For those plants where "retrofit" costs were reported, retrofit costs of less than 6% of pollution control costs were reported for 73% of the plants. On the basis of these survey responses, the Agency concludes that "age" of plants does not have a significant impact on the cost of retrofitting pollution controls on an industry wide basis.

The Agency's examination of the Mahoning Valley plants also supports the conclusion that "age" of plants does not significantly impact the "cost or feasibility" of retrofitting.

This examination, discussed above in regard to "site-specific" costs, showed that, for eight of the oldest plants in the country, the industry's estimated compliance costs do not vary significantly from the agency's model cost estimates.

On the basis of the foregoing, the Agency concludes that plant "age" does not significantly affect the "cost or feasibility" of retrofitting water pollution controls. However, even assuming that "age" does significantly impact the "cost or feasibility" of retrofitting, the Agency concludes that altered subcategorization or relaxed requirements within subcategories for "older" plants are not warranted. "Older" steel facilities are responsible for as much water pollution as "newer" facilities. Thus, even if it could be shown that plant "age" did affect the "cost or feasibility" of retrofitting controls, the Agency would not alter its subcategorization or provide relaxed effluent limitations or standards within subcategories for "older" plants as control of the discharge of pollutants from those plants justify the expenditures of reasonable additional costs.

Based upon the above, the Agency finds that both old and newer production facilities within each subcategory generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within each subcategory on the basis of age is not appropriate.

3. The Impact of the Regulation on Consumptive Water Loss

In the 1974 BPT and BAT regulation for the steelmaking segment, many of the Agency's model treatment systems include partial recycle of wastewaters. Some of these model systems included evaporative cooling towers to insure that the temperature of recycled wastewater not reach excessive levels for process use.[12] CF&I Steel Corporation, located in Pueblo, Colorado, claimed that cooling through evaporative means would cause additional consumptive water losses which would be inconsistent with state law and would aggravate water scarcity in arid and semi-arid regions of the country. The Court held that to the extent that the regulations were inconsistent with state law, the Supremacy Clause of the U.S. Constitution required that federal law and regulations prevail. The Court agreed with CF&I, however, in holding that the Agency had failed to adequately consider the impact of the regulation on water sources in arid and semi-arid regions.

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[12] The treatment models that included evaporative cooling towers were the BPT and BAT models in the cokemaking, blast furnace, steelmaking, vacuum degassing, and continuous casting subcategories. Although there are other available means of temperature equalization (such as lagoons and nonevaporative coolers), only cooling towers were included in those treatment models.

The 1976 regulation for the forming and finishing segment also included treatment models with evaporative cooling towers.[13] In its response to CF&I's comments, the Agency stated:

"A means to dissipate heat is frequently a necessity if a recycle system is to be employed. The evaporation of water in cooling towers or from ponds is the most commonly employed means to accomplish this. However, fin-tube heat exchangers can be used to achieve cooling without evaporation of water. Such systems are used in the petroleum processing and electric utility industries.

The Agency also feels that recognition of the evaporation of water in recycle systems (and hence loss of availability to potential downstream users) should be balanced with recognition that evaporation also occurs in once-through systems, when the heated discharge causes evaporation in the stream. This is not an obvious phenomenon, since it occurs downstream of the discharge point, but to the downstream user it is as real as with consumptive in-plant usage. Assuming that the stream eventually gets back to temperature equilibrium with its environment, it will get there primarily by evaporation, i.e., with just as certain a loss of water. Additionally, the use of a recycle system permits lessening the intake flow requirements." 41 FR 12990.

In addition, in its brief the Agency argued that, because of current evaporative losses, the impact of the regulations was not as severe as claimed by CF&I, and that the water scarcity issue was pertinent only in arid and semi-arid regions of the country. The Court, however, held:

"...Since EPA may have proceeded under a mistaken assumption of fact as to the water loss attributable to the interim final [Phase II] regulations, the matter will be remanded to the Agency for further consideration of whether fin-tube heat exchangers or dry type cooling towers may be employed despite any fouling or scaling problems - assuming that cooling systems of some kind will be employed in order to meet the effluent limitations prescribed in the regulations.

Also, the Agency may not decline to estimate the water loss due to the interim final regulations as accurately as possible on the grounds that, whatever the cost in water consumption, the specified effluent limitations are justified. In order to insure that the Agency completes a sufficiently specific and definite study of the water consumption problem on remand, the Agency must address the question of how often the various cooling systems will be employed, or present reasons why it cannot make such an assessment."

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[13] The treatment models that included evaporative cooling towers were the BAT models in the hot forming subcategories.

In light of these decisions, the Agency has evaluated the "consumptive water loss" issue in the context of this regulation. Several of the underlying model treatment systems include recycle of wastewaters with evaporative cooling systems. Although cooling can be accomplished by several means (i.e.,lagoons, spray ponds, dry cooling towers), the model treatment systems are based upon evaporative cooling towers, which are the most commonly used, least space intensive, and among the least costly means of cooling wastewaters. Additionally, evaporative cooling towers have the highest water consumption rates. Thus, the Agency's estimates of water loss are conservative and overstate actual water loss. In evaluating possible consumptive water losses, however, the Agency has also analyzed the effects of several cooling mechanisms other than evaporative cooling towers.

On the average, the steel industry currently uses 5.7 billion gallons of process water per day. Not all of the process water requires cooling. A breakdown of this water usage by subcategory is given in Table III-6. Large volumes of this process water are currently recycled through cooling towers, cooling ponds, and spray ponds as shown below:

| Cooling Device* | Approximate Evaporation Rate | % Utilization |
|---|---|---|
| (1) Cooling Tower (wet-mechanical draft) | 2.0% | 75% |
| (2) Cooling ponds | 1.7% | 20% |
| (3) Spray ponds | 2.0% | 5% |

* The Agency does not expect any significant use of dry cooling towers in the steel industry.

Based upon the foregoing, the Agency estimates that evaporative losses from currently installed recycle/cooling systems, and from once-through discharges of heated water is about 16.0 MGD or 0.3% of total industry process water usage. The Agency estimates that nearly 50% of this consumption results from the once-through discharge of heated wastewater and run-of-the-river cooling.

Assuming that the relative utilization rate of the various cooling mechanisms remains the same, the Agency estimates that total evaporative water losses will be 19.8 MGD or 0.3% of process water usage at the BPT level, and 20.2 MGD or 0.4% of process water usage at the BAT level when fully implemented.

The important factor for regulatory purposes, however, is not the above gross water losses, but the additional or net water loss attributable to compliance with the regulation. This analysis indicates that net water losses attributable to compliance with the regulation will be 3.8 MGD or less than 0.1% of process water usage at the BPT level and 4.2 MGD or 0.1% of process water usage at the BAT level, including water consumed at the BPT level. This analysis is detailed for those subcategories, where recycle and cooling systems are envisioned, in Table III-7 and is summarized below:

| | Flow per Day (MGD) | % of Total |
|---|---|---|
| Total process water used | 5744 | 100.0 |
| Present water consumption[1] | 16.0 | 0.3 |
| Gross water consumption @ BPT | 19.8 | 0.3 |
| Net water consumption @ BPT | 3.8 | 0.07 |
| Gross water consumption @ BAT[2] | 20.2 | 0.4 |
| Net water consumption @ BAT[2] | 4.2 | 0.07 |

[1] As of January 1, 1978.
[2] This total includes the water consumed at BPT.

Assuming that cooling towers will be installed at all plants requiring additional cooling (rather than current utilization devices), the net water losses attributable to compliance with the regulation would be 5.7 MGD or 0.1% of total process water usage at the BPT level and 6.0 MGD or 0.1% of process water usage at the BAT level. For purposes of estimating consumptive water losses on a subcategory basis, the Agency made the conservative assumption that evaporative cooling towers would be used in all cases where a cooling device of some kind was deemed necessary. 12454

In the Agency's view, the water consumption attributable to compliance with the regulation is not significant when compared to the benefits derived from the use of recycle systems. The use of recycle systems at the BPT, BAT, and PSES levels will result in a 70% reduction in the total process water usage of the industry. This reduction will prevent 4.0 billion gallons of water per day from being contaminated in steel manufacturing processes. Moreover, recycle systems permit a reduction in the load of pollutants by over 11 million tons per year at the BAT level (including 131,500 tons/year of toxic organic and toxic inorganic pollutants). Finally, it is significant to note that the use of recycle systems is often the least costly means to reduce pollution. On a nation-wide basis, therefore, EPA concludes that the environmental and economic benefits of recycle systems justify the evaporative water losses attributable to cooling mechanisms.

In addition, the Agency evaluated the water consumption issue as it relates to plants in arid and semi-arid regions. The Agency surveyed the four major steel plants it considers to be in arid or semi-arid regions of the country. Those plants are as follows.

| | |
|---|---|
| 0196A | CF&I Steel Corporation<br>Pueblo, Colorado |
| 0448A | Kaiser Steel Corporation<br>Fontana, California |
| 0492A | Lone Star Steel Company<br>Lone Star, Texas |
| 0864A | United States Steel Corporation<br>Provo, Utah |

The Agency finds that most of the recycle and evaporative cooling systems included in the model treatment systems which are the bases for the promulgated limitations and standards have been installed at those plants. Thus, these plants are already incurring most, if not all, of the consumptive water losses associated with compliance with the regulation. Hence, the incremental impact of the regulation on water consumption at steel plants located in arid or semi-arid regions is either minimal or nonexistant.

Despite the significant benefits and relatively small evaporative losses from recycle/cooling systems, CF&I of Pueblo, Colorado, claims that recycle/cooling systems will cause severe problems by compounding the water scarcity problems in the arid and semi-arid regions of the country. Therefore, this company suggests that required effluent levels be based on once-through systems or less stringent recycle rates in arid or semi-arid areas.

The Agency believes this proposal to be deficient in several respects. First, discharging the heated wastewaters once-through would not conserve a significant amount of water. For example, for an average sized steel mill with a 100 MGD process flow, discharging wastewaters once-through would only conserve 0.4 MGD or 0.4% of the total process water flow, a very small water savings. The savings is small because even in a once-through system, a certain amount of water is evaporated (the evaporation will occur in the receiving body of water as the temperature of the heated wastewaters approaches the equilibrium temperature of the receiving stream or lake). In this case, the evaporation rate is approximately one-half of the evaporation rate of a cooling tower. However, while a small water savings is achieved, certain disadvantages result, some of which are outlined below:

a. A heated discharge (potentially up to 150°) which may cause localized environmental damage will be allowed to enter a receiving water.

b. The once-through system will allow a significantly higher pollutant load to enter the receiving water.

c. The once-through system will require additional water to be taken from the water supply to meet the water requirements of the steelmaking operations.

While the use of recycle/cooling systems now results in some additional evaporative water losses in arid and semi-arid regions, the Agency believes that here, too, the benefits of recycle systems justify these losses. The Agency considered establishing alternative limitations for facilities located in arid and semi-arid regions, but concluded that alternative limitations and, thus, separate subcategories are not appropriate.

With respect to fouling and scaling of wet cooling towers, the Agency believes that the only operation at which this could possibly be a problem is blast furnace recirculation systems. The industry, however, has not indicated it has had no significant fouling or scaling problems with these systems.

TABLE III-1

YOUNGSTOWN SHEET AND TUBE CAPITAL COSTS

| Treatment Systems | YS&T | EPA | BATEA Scaled By Flow | BATEA Scaled By Production Rate | Site Costs | BATEA + Site Costs Scaled By Flow | BATEA + Site Costs Scaled By Production Rate |
|---|---|---|---|---|---|---|---|
| I Electric Weld Tube Brier Hill | 1,018,000 | 985,000 | 216,000 | 1,113,000 | 602,000 | 818,000 | 1,715,000 |
| II Blooming Mill Brier Hill | 5,390,000 | 5,141,000 | 5,114,000 | 10,645,000 | 1,150,000 | 6,264,000 | 11,795,000 |
| III Blast Furnace Brier Hill | 1,576,000* | 1,522,000 | 980,000 | 1,466,000 | 1,151,000 | 2,131,000 | 2,617,000 |
| IV Seamless Tube Campbell | 3,562,000 | 3,595,000 | 2,890,000 | 2,284,000 | 748,000 | 3,638,000 | 3,032,000 |
| V&VA Cold Reduced Mill Campbell | 3,817,000 | 3,523,000 | 2,466,000 | 2,771,000 | 507,000 | 2,973,000 | 3,278,000 |
| VI Central Treatment Campbell | 25,221,000 | 25,007,000 | 28,656,000 | 30,331,000 | 10,321,000 | 38,997,000 | 40,652,000 |
| VII Coke Plant Campbell | 8,973,000 | 7,300,000 | 6,822,000 | 7,691,000 | 2,074,000 | 8,896,000* | 9,765,000 |
| VIII Galvanized Conduit Struthers | 1,179,000 | 860,000 | 596,000 | 493,000 | 266,000 | 862,000 | 759,000 |
| IX Merchant Mill Struthers | 3,370,000 | 3,283,000 | 5,478,000 | 3,774,000 | 1,357,000 | 6,835,000 | 5,131,000 |
| TOTAL | 54,106,000 | 51,214,000 | 53,218,000 | 60,568,000 | 18,176,000 | 71,394,000 | 78,744,000 |
| HCl Regeneration Campbell | 3,470,000 | | | | | | |
| Blast Furnace Cambpill | 2,262,000 | | | | | | |
| Cold Drawn Bar Brier Hill | 84,000 | | | | | | |
| TOTAL | 59,922,000 | | | | | | |

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*: Includes 325,000 for blowdown treatment.

TABLE III-2

UNITED STATES STEEL CAPITAL COSTS

| Treatment Systems | USS | EPA | BATEA T.M. Scaled by Flow | BATEA T.M< Scaled by Production | Site Costs | BATEA T.M. + Site Costs by Flow | BATEA T.M. + Site Costs by Production |
|---|---|---|---|---|---|---|---|
| McDonald Plant | 12,800,000 | 12,131,000 | 17,612,000 | 19,787,000 | 4,400,000 | 22,012,000 | 24,187,000 |
| Rolling Mills (Outfall 005) | | | | | | | |
| Batch & Continuous Pickling (Outfall 006) | 550,000 | 549,000 | 586,000 | 586,000 | 35,000 | 621,000 | 603,000 |
| Ohio Plant | 13,440,000(1) | 11,479,000 | 5,288,000(2) | 5,179,000(2) | 6,000,000(2) | 11,288,000(2) | 11,179,000(2) |
| Blast Furnace (Outfall 001) | | | | | | | |
| Rolling Mills (Outfall 003) | 5,800,000 | 5,675,000 | 3,842,000 | 8,453,000 | 2,500,000 | 6,342,000 | 10,953,000 |
| Batch Pickling (Outfall 004) | 520,000 | 540,000 | 441,000 | 402,000 | 210,000 | 651,000 | 612,000 |
| TOTAL | 33,110,000 | 30,374,000 | 27,769,000 | 34,389,000 | 13,145,000 | 40,914,000 | 47,534,000 |

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(1) Including dismantling of blast furnace.
(2) With base level of treatment.

## TABLE III-3

## REPUBLIC STEEL CAPITAL COSTS**

| Treatment Systems | Republic BPCTCA | BPCTCA Module Scaled By Flow | BPCTCA Module Scaled By Production | BATEA Module Scaled By Flow | BATEA Module Scaled By Production | Site Costs | BPCTCA By Flow + Site Costs | BPCTCA By Production + Site Costs | BATEA By Flow + Site Costs | BATEA By Production + Site Costs |
|---|---|---|---|---|---|---|---|---|---|---|
| Warren Plant | | | | | | | | | | |
| Finishing Mills Area | 8,000,000 | 5,879,000 | 14,387,000 | 8,765,000 | 23,943,000 | 1,294,000 | 7,458,000 | 15,681,000 | 10,059,000 | 25,237,000 |
| Finishing Mills Pickling | 8,800,000 | 9,610,000 | 12,243,000 | 9,678,000 | 12,330,000 | 0 | 9,610,000 | 12,243,000 | 9,678,000 | 12,330,000 |
| Hot Rolling Mills Area | 9,700,000 | 8,518,000 | 12,543,000 | 11,826,000 | 21,075,000 | 7,645,000 | 16,163,000 | 20,188,000 | 19,471,000 | 28,720,000 |
| Blast Furnace Area | 7,300,000 | 3,676,000 | 4,444,000 | 4,105,000 | 4,968,000 | 1,468,000 | 5,144,000 | 5,912,000 | 5,571,000 | 6,436,000 |
| Coke Plant | | | | | | | | | | |
| Physical/Chemical | 8,000,000 | 187,000 | 189,000 | 1,121,000 | 937,000 | 566,000 | 753,000 | 755,000 | 1,681,000 | 1,503,000 |
| | | 5,173,000* | 5,218,000* | 6,106,000* | 5,966,000* | 566,000 | 5,739,000* | 5,784,000* | 6,672,000* | 6,532,000* |
| Biological | 8,000,000 | 414,000 | 519,000 | 1,207,000 | 1,074,000 | 566,000 | 1,080,000 | 1,085,000 | 1,773,000 | 1,640,000 |
| | | 5,500,000* | 5,548,000* | 6,193,000* | 6,103,000* | 566,00 | 6,066,000* | 6,144,000* | 6,759,000* | 6,699,000* |
| Youngstown Plant | | | | | | | | | | |
| Poland Avenue | 10,899,000 | 4,501,000 | 8,010,000 | 8,742,000 | 14,633,000 | 3,314,000 | 7,815,000 | 11,324,000 | 12,056,000 | 17,947,000 |
| Blast Furnaces | 7,900,000 | 5,388,000 | 5,417,000 | 6,023,000 | 6,054,000 | 0 | 5,388,000 | 5,417,000 | 6,023,000 | 6,054,000 |
| Coke Plant | | | | | | | | | | |
| Physical/Chemical | 7,700,000 | 193,000 | 296,000 | 959,000 | 1,466,000 | 535,000 | 728,000 | 831,000 | 1,494,000 | 2,001,000 |
| | | 5,333,000* | 8,164,000* | 6,099,000* | 9,335,000 | 535,000 | 5,868,000* | 8,699,000* | 6,634,000* | 9,870,000 |
| Biological | 7,700,000 | 530,000 | 812,000 | 1,054,000 | 1,680,000 | 535,000 | 1,065,000 | 1,347,000 | 1,594,000 | 2,215,000 |
| | | 5,670,000* | 8,680,000* | 6,239,000* | 9,549,000 | 535,000 | 6,205,000* | 9,216,000* | 6,774,000* | 10,084,000 |
| Miles Plant | 1,800,000 | 2,852,000 | 2,214,000 | 3,160,000 | 2,386,000 | 768,000 | 3,620,000 | 2,982,000 | 3,928,000 | 3,154,000 |
| TOTAL | 70,099,000 | | | | | | | | | |
| Physical/Chemical* | | 50,930,000 | 72,640,000 | 64,504,000 | 100,690,000 | 15,590,000 | 66,815,000 | 88,230,000 | 80,094,000 | 116,280,000 |
| Biological* | | 51,594,000 | 73,486,000 | 64,731,000 | 101,041,000 | 15,590,000 | 67,479,000 | 89,076,000 | 80,321,000 | 116,631,000 |

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* : Including Level A Costs.

**: BPCTCA and BATEA costs are based on March, 1975 dollar values.

## TABLE III-4

## PLANT AGE ANALYSIS[(1)]
## IRON & STEEL INDUSTRY

| Subcategory | 1919 and before | 1920 to 1929 | 1930 to 1939 | 1940 to 1949 | 1950 to 1959 | 1960 to 1969 | 1970 and later |
|---|---|---|---|---|---|---|---|
| A. Cokemaking | 33 | 16 | 0 | 6 | 5 | 3 | 3 |
| B. Sintering | 0 | 0 | 1 | 7 | 8 | 2 | 3 |
| C. Ironmaking | 68 | 12 | 8 | 31 | 28 | 11 | 6 |
| D. Steelmaking | | | | | | | |
| 1. BOF | 0 | 0 | 0 | 0 | 2 | 21 | 8 |
| 2. Open Hearth | 0 | 0 | 0 | 1 | 4 | 0 | 0 |
| 3. Electric Arc | 0 | 0 | 0 | 1 | 2 | 4 | 5 |
| E. Vacuum Degassing | 0 | 0 | 0 | 0 | 7 | 21 | 10 |
| F. Continuous Casting | 0 | 0 | 0 | 0 | 0 | 23 | 36 |
| G. Hot Forming | | | | | | | |
| 1. Primary | 33 | 12 | 11 | 14 | 26 | 11 | 4 |
| 2. Section | 67 | 49 | 21 | 29 | 33 | 23 | 14 |
| 3. Flat | | | | | | | |
| a. Strip & Sheet | 4 | 9 | 11 | 3 | 14 | 12 | 2 |
| b. Flat Plate | 10 | 1 | 3 | 1 | 2 | 6 | 2 |
| 4. Pipe & Tube[(2)] | 5 | 8 | 11 | 7 | 11 | 4 | 2 |

TABLE III-4
PLANT AGE ANALYSIS
IRON & STEEL INDUSTRY
PAGE 2

| Subcategory | 1919 and before | 1920 to 1929 | 1930 to 1939 | 1940 to 1949 | 1950 to 1959 | 1960 to 1969 | 1970 and later |
|---|---|---|---|---|---|---|---|
| H. Scale Removal | 0 | 0 | 0 | 4 | 12 | 9 | 4 |
| I. Acid Pickling | | | | | | | |
| 1. Sulfuric Acid | 15 | 16 | 25 | 41 | 43 | 31 | 14 |
| 2. Hydrochloric Acid | 1 | 1 | 17 | 14 | 17 | 38 | 7 |
| 3. Combination Acid | 6 | 16 | 9 | 22 | 25 | 36 | 11 |
| J. Cold Forming | | | | | | | |
| 1. CR-Recirculation | 21 | 4 | 11 | 23 | 28 | 32 | 13 |
| 2. CR-Combination | 0 | 0 | 1 | 3 | 5 | 8 | 2 |
| 3. CR-Direct | 0 | 28 | 18 | 5 | 8 | 7 | 1 |
| 4. Pipe & Tube | 0 | 4 | 7 | 8 | 23 | 34 | 20 |
| K. Alkaline Cleaning | 0 | 4 | 20 | 14 | 41 | 59 | 23 |
| L. Hot Coating | 5 | 16 | 20 | 26 | 40 | 51 | 12 |

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(1) Ages based on first year of production.
(2) Does not include the ages for four confidential plants.
Note: Count based on number of individual operations.

## TABLE III-5

## EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY

| Subcategory | Plant Reference Code | Plant Age* (Year) | Treatment Age (Year) |
|---|---|---|---|
| A. Cokemaking | 012A | 1920 | 1977 |
| | 024A | 1916 | 1953-1977 |
| | 024B | 1901 | 1969-1977 |
| | 112A | 1920 | 1977 |
| | 272 | 1919 | 1957-1977 |
| | 396A | 1906-1955 | 1972 |
| | 432B | 1919-1961 | 1930-1972 |
| | 464C | 1925-1973 | 1971 |
| | 464E | 1914-1970 | 1914-1977 |
| | 584F | 1923-1971 | 1977 |
| | And Others | | |
| B. Sintering | 060B | 1958 | 1968 |
| | 060F | 1957 | 1975 |
| | 112B | 1950 | 1970 |
| | 112C | 1948 | 1960 |
| | 448A | 1943 | 1971 |
| | 548C | 1959 | 1965 |
| | 584C | 1959 | 1965 |
| | 864A | 1944 | 1962 |
| | 868A | 1941 | 1954 |
| | 920F | 1944 | 1973 |
| | 946A | 1939 | 1972 |
| C. Ironmaking | 060B | 1942 | 1958 |
| | 112A | 1941 | 1948 |
| | 320 | 1920-1947 | 1976 |
| | 396A | 1907-1909 | 1929 |
| | 396C | 1903-1905 | 1929 |
| | 426 | 1958 | 1979 |
| | 432A | 1910-1919 | 1951 |
| | 432B | 1900-1966 | 1930 |
| | 584C | 1956-1961 | 1965 |
| | 584D | 1904-1911 | 1953 |
| | And Others | | |

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 2

| Subcategory | Plant Reference Code | Plant Age* (Year) | Treatment Age (Year) |
|---|---|---|---|
| D. Steelmaking | | | |
| 1. Basic Oxygen Furnace | 432C | 1961 | 1964 |
| | 684C | 1970 | 1971 |
| | 684F | 1966 | 1976 |
| | 724F | 1966 | 1976 |
| 2. Open Hearth | 060 | 1952 | 1970 |
| | 112A | 1957 | 1971 |
| | 492A | 1953 | 1966 |
| | 864A | 1944 | 1962 |
| | 748C | 1952 | 1967 |
| 3. Electric Furnace | 060F | 1951 | 1968 |
| | 432C | 1959 | 1964 |
| | 528A | 1949 | 1954 |
| | 612 | 1936 | 1971 |
| E. Vacuum Degassing | 88A | 1963-1968 | 1971 |
| | 496 | 1965 | 1971 |
| F. Continuous Casting | 084A | 1970-1975 | 1975 |
| | 432A | 1969 | 1974 |
| | 476A | 1969 | 1977 |
| | 584 | 1968 | 1970 |
| | 652 | 1968 | 1971 |
| | 780 | 1966-1975 | 1975 |
| G. Hot Forming | | | |
| 1. Hot Forming - Primary | 020B | 1948 | 1971 |
| | 060D | 1910 | 1959 |
| | 060I | 1941 | 1958 |
| | 088D | 1959 | 1971 |
| | 112 | 1907 | 1979 |
| | 112A | 1930 | 1970 |
| | 112B | 1928 | 1970 |
| | 176 | 1917 | 1965 |
| | 188A | 1959 | 1970 |
| | 188B | 1940 | 1946 |
| | 248C | 1962 | 1975 |
| | 320 | 1936 | 1952 |
| | And Others | | |

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 3

| Subcategory | Plant Reference Code | Plant Age* (Year) | Treatment Age (Year) |
|---|---|---|---|
| 2. Hot Forming - Section | 060C | 1913 | 1920-1975 |
| | 060F | 1942 | 1965 |
| | 060I | 1956 | 1958 |
| | 060K | 1920 | 1955 |
| | 088D | 1962 | 1971 |
| | 112 | 1907 | 1954-1979 |
| | 112A | 1937 | 1971-1977 |
| | 112F | 1922 | 1947-1978 |
| | 136B | 1908 | 1959-1969 |
| | 316 | 1959 | 1966 |
| 3. Hot Forming - Flat | | | |
| a. Plate | 112C | 1902 | 1964 |
| | 424 | 1970 | 1971-1978 |
| | 448A | 1943 | 1948 |
| | 496 | 1918 | 1948-1977 |
| | 860B | 1936 | 1967 |
| b. Hot Strip & Sheet | 020B | 1953 | 1971 |
| | 396D | 1960 | 1970 |
| | 432A | 1957 | 1974 |
| | 476A | 1915 | 1977 |
| | 684F | 1937 | 1969 |
| | 856D | 1938 | 1980 |
| | 856P | 1929 | 1966 |
| 4. Pipe and Tube | 060C | 1913 | 1948 |
| | 060F | 1950 | 1971 |
| | 060R | 1930-1947 | 1961 |
| | 432A | 1957-1958 | 1974 |
| | 476A | 1930 | 1977 |
| | 548A | 1945-1960 | 1969 |
| | 652A | 1954 | 1962 |
| | 728 | 1929 | 1952 |
| | 856N | 1930 | 1961 |
| | 856Q | 1930 | 1963 |
| | And Others | | |

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 4

| Subcategory | Plant Reference Code | Plant Age* (Year) | Treatment Age (Year) |
|---|---|---|---|
| H. Scale Removal | 060I | 1970 | 1972 |
| | 088A | 1962 | 1969 |
| | 256L | 1962 | 1969 |
| | 424 | 1971 | 1978 |
| | 284A | 1957 | 1971 |
| | 176 | 1941 | 1965 |
| | 256K | 1956 | 1971 |
| | 248B | 1950 | 1978 |
| I. Acid Pickling | | | |
| 1. Sulfuric Acid | 020B | 1954 | 1974 |
| | 048F | 1944 | 1969 |
| | 060D | 1957 | 1968 |
| | 060M | 1970 | 1977 |
| | 088A | 1936 | 1969 |
| | 088D | 1962 | 1971 |
| | 112 | 1922 | 1977 |
| | 112C | 1926 | 1977 |
| | 256F | 1953 | 1975 |
| | 384A | 1958 | 1964 |
| | And Others | | |
| 2. Hydrochloric Acid | 020C | 1946 | 1977 |
| | 112B | 1936 | 1971 |
| | 176 | 1961 | 1956 |
| | 320 | 1936 | 1955 |
| | 384A | 1932 | 1970 |
| | 396D | 1967 | 1969 |
| | 432C | 1952 | 1964 |
| | 448A | 1954 | 1970 |
| | 580A | 1962 | 1967 |
| | And Others | | |
| 3. Combination Acid | 020B | 1947 | 1974 |
| | 088A | 1952 | 1969 |
| | 112A | 1926 | 1977 |
| | 112H | 1940 | 1951 |
| | 256F | 1953 | 1975 |
| | 284A | 1957 | 1971 |
| | 584D | 1940 | 1970 |
| | 860F | 1962 | 1977 |
| | And Others | | |

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 5

| Subcategory | Plant Reference Code | Plant Age* (Year) | Treatment Age (Year) |
|---|---|---|---|
| J. Cold Forming | | | |
| | 020C | 1951 | 1975 |
| | 060 | 1936 | 1967 |
| | 112A | 1947 | 1971 |
| | 112B | 1936 | 1971 |
| | 176 | 1921 | 1963 |
| | 396D | 1938 | 1959 |
| | 432B | 1937 | 1966 |
| | 448A | 1952 | 1969 |
| | 584A | 1948 | 1971 |
| | 684D | 1939 | 1970 |
| | And Others | | |
| K. Alkaline Cleaning | 112A | 1936 | 1971-1977 |
| | 112I | 1927 | 1950-1977 |
| | 240B | 1938 | 1968 |
| | 256N | 1956 | 1973 |
| | 384A | 1968 | 1970 |
| | 432A | 1940 | 1970 |
| | 448A | 1959 | 1969 |
| | 476A | 1960 | 1977 |
| | 548A | 1957 | 1967 |
| | 580A | 1962 | 1967 |
| | And Others | | |
| L. Hot Coating | 112B | 1962 | 1971 |
| | 112G | 1922 | 1973 |
| | 384A | 1968 | 1970 |
| | 448A | 1967 | 1970 |
| | 460A | 1932 | 1968 |
| | 476A | 1930 | 1977 |
| | 492A | 1962 | 1976 |
| | 580A | 1962 | 1967 |
| | 584C | 1956 | 1965 |
| | 640 | 1936 | 1961 |

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* Where ranges of ages are listed, this shows that these are multiple facilities on site that vary in age as indicated.

## TABLE III-6

## WATER USAGE IN THE STEEL INDUSTRY

| Subcategory | Total Process Water Usage (MGD) | Water Recycled Over Cooling Systems at BPT (MGD) | Water Recycled Over Cooling Systems at BAT (MGD) |
|---|---|---|---|
| A. Cokemaking | 32.5 | 32.4(1) | 42.0(1) |
| B. Sintering | 99.2 | 0 | 0 |
| C. Ironmaking | 864.0 | 738.0 | 751.2 |
| D. Steelmaking | 273.3 | 0 | 0 |
| E. Vacuum Degassing | 55.4 | 54.4 | 54.4 |
| F. Continuous Casting | 233.2 | 220.1 | 226.4 |
| G. Hot Forming | 3,974.4 | 0 | 0 |
| H. Salt Bath Descaling | 1.1 | 0 | 0 |
| I. Acid Pickling | 86.7 | 0 | 0 |
| J. Cold Forming | 76.5 | 0 | 0 |
| K. Alkaline Cleaning | 17.5 | 0 | 0 |
| L. Hot Coating | 30.4 | 0 | 0 |
|  | 5,744.2 | 1012.5 | 1032.4 |

---

(1) Flow not included as part of the total process water flow.

## TABLE III-7

## CONSUMPTIVE USE OF WATER (BY EVAPORATION IN COOLING SYSTEMS) IN THE STEEL INDUSTRY[1]

| Subcategory | Present Water Consumption (MGD) | Additional Consumption at BPT over Present (MGD) | Water Consumption Anticipated at BPT (MGD) | Additional Consumption at BAT over Present (MGD) | Water Consumption Anticipated at BAT (MGD) |
|---|---|---|---|---|---|
| A. Cokemaking | 0.69 | 0.16 | 0.85 | 0.40 | 1.09 |
| C. Ironmaking | 11.21 | 2.99 | 14.20 | 3.09 | 14.30 |
| E. Vacuum Degassing | 0.70 | 0.25 | 0.95 | 0.25 | 0.95 |
| F. Continuous Casting | 3.44 | 0.40 | 3.84 | 0.25 | 3.88 |
|  | 16.04 | 3.80 | 19.84 | 4.18 | 20.22 |

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(1) Only those subcategories which utilize recycle and cooling systems are included in this analysis.

# VOLUME I

## SECTION IV

## INDUSTRY SUBCATEGORIZATION

To develop the regulation it was necessary for the Agency to determine whether different effluent limitations and standards should be developed for distinct segments or subcategories of the steel industry. The Agency's subcategorization of the industry included an examination of the same factors and rationale described in the Agency's previous studies. Those factors are:

1. Manufacturing processes and equipment
2. Raw materials
3. Final products
4. Wastewater characteristics
5. Wastewater treatment methods
6. Size and age of facilities
7. Geographic location
8. Process water usage and discharge rates
9. Costs and economic impacts

For this regulation, the Agency has adopted a revised subcategorization of the industry to more accurately reflect production operations and to simplify the use of the regulation. The Agency found that the manufacturing process is the most significant factor and divided the industry into 12 main process subcategories on this basis. Section IV of each subcategory report contains a detailed discussion of the factors considered and the rationale for selecting and subdividing the subcategories. The Agency determined that process-based subcategorization is warranted in many cases because the wastewaters of the various processes contain different pollutants requiring treatment by different control systems (e.g., phenols by biological systems in cokemaking). However, in some cases, the wastewaters of different processes were found to have similar characteristics. In those instances, the Agency determined that subcategorization was appropriate because the process water usage and discharge flow rates varied significantly, thus affecting estimates of treatment system costs and pollutant discharges. The twelve subcategories of the steel industry are as follows:

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A. Cokemaking
B. Sintering
C. Ironmaking
D. Steelmaking
E. Vacuum Degassing
F. Continuous Casting
G. Hot Forming
H. Salth Bath Descaling
I. Acid Pickling
J. Cold Forming
K. Alkaline Cleaning
L. Hot Coating

The subcategories of the steel industry are defined below. Also discussed are any subdivisions and segments within the main subcategories and the rationale for the subdivision and segmentation.

Subcategory A: Cokemaking

Cokemaking operations involve the production of coke in by-product or beehive ovens. The production of metallurgical coke is an essential part of the steel industry, since coke is one of the basic raw materials necessary for the operation of ironmaking blast furnaces.

Significant variations exist in the quantity and quality of waste generated between the old beehive ovens and the newer by-product ovens. In order to prepare effluent limitations and standards that would adequately reflect these variations, a subdivision of the Cokemaking subcategory was necessary. The first subdivision is By-Product Cokemaking, a method employed by 99 percent of the coke plants in the U.S. In by-product ovens, coke oven gas, light oil, ammonium sulfate and sodium phenolate are recovered rather than allowed to escape to the atmosphere. This subdivision has been further segmented to reflect the slightly different wastewater volume generation rates between coke plants located at integrated steel plants and at merchant coke plants. Within both segments, there are further distinctions based upon type of treatment (physical/chemical and biological), type of ammonia recovery process utilized (semi-direct vs. indirect) and an added allowance for plants employing wet desulfurization systems.

Beehive Cokemaking is the other subdivision in the Cokemaking subcategory. This process is only found in one percent of the U.S. cokemaking operations. In beehive ovens no effort is made to recover volatile materials generated by the process so there is no wastewater generated from gas cleaning as in the by-product plants. The wastewater results from the direct spraying of water on the hot coke to stop the coking process.

Subcategory B: Sintering

Sintering operations involve the production of an agglomerate which is then reused as a feed material in iron and steelmaking processes.

This agglomerate or "sinter" is made up of large quantities of particulate matter (fines, mill scale, flue dust) which have been generated by blast furnaces, open hearth furnaces, and basic oxygen furnaces, and scale recovered from hot forming operations.

Wastewaters are generated in sintering operations as a result of the scrubbing of dusts and gases produced in the sintering process. Quenching and cooling of the sinter, practiced at some plants, generates additional wastewaters. The Agency determined that model plant effluent flow rates can be achieved at sinter plants with wet air pollution controls on all parts of the sintering operation. Since there are no significant variations in wastewater quality from these operations, the Agency did not subdivide sintering operations on the basis of the type of wet air pollution control system used or the part of the sintering operation controlled by wet air pollution control systems.

### Subcategory C: Ironmaking

Ironmaking operations involve the conversion of iron bearing materials, limestone, and coke into molten iron in a reducing atmosphere in a tall cylindrical furnace. The gases produced as a result of this combustion are a valuable heat source but require cleaning prior to reuse. Blast furnace wastewaters are generated as a result of the scrubbing and cooling of these off-gases. Both pig-iron and ferromanganese can be produced in blast furnace operations. Because the wastewaters produced at these two types of operations vary significantly, different BPT limitations were promulgated. However, BAT, NSPS, PSES and PSNS were promulgated only for ironmaking blast furnaces since no ferromanganese furnaces are in operation or scheduled for operation and ferroalloy production has shifted to electric furnaces.

### Subcategory D: Steelmaking

Steelmaking operations involve the production of steel in basic oxygen, open hearth, and electric arc furnaces. These furnaces receive iron produced in blast furnaces along with scrap metal and fluxing materials. During steelmaking, large quantities of fume, smoke, and waste gases are generated which require cleaning prior to emission to the atmosphere. Steelmaking wastewaters are generated as a result of some of the gas cleaning operations.

Each of the three types of furnaces operates differently. These differences result in significant variations in wastewater volume, pollutant loads generated, and wastewater characteristics. In order to develop effluent limitations that would adequately reflect these variations, the Agency determined that subdivision of the Steelmaking subcategory into the following three subdivisions is appropriate: Basic Oxygen Furnace; Open Hearth Furnace; and Electric Arc Furnace. The Agency also determined that further segmentation of the BOF and EAF subdivisions is appropriate because of differences in the methods used to clean and condition furnace gases.

Three different scrubbing systems, each of which could result in a wastewater discharge, are presently used to clean waste gases from basic oxygen furnaces: semi-wet; wet-suppressed combustion; and wet-open combustion. Water is used in semi-wet systems to cool and condition furnace gases to optimize the performance of the electrostatic precipitators or baghouses that are relied upon to clean the gases. These systems are characterized by wastewaters containing relatively small quantities of particulate matter having a large particle size. Wet systems result in much higher raw wastewater pollutant loadings due to the increased amount of water used. In an open combustion system, 90 percent of the particulates are of a submicron size, because combustion is more complete. By comparison, suppressed combustion systems generate larger particles, of which only 30-40 percent are of submicron size. Since much of the heavier particulate matter remains in the furnace, the suspended solids loadings in the wastewaters from suppressed combustion systems are much lower.

Both semi-wet and wet systems are used at electric furnaces while only wet systems are used at open hearth furnaces. The subdivision of the Steelmaking subcategory takes the wastewater flow and quality differences into account.

## Subcategory E: Vacuum Degassing

Vacuum degassing is the process whereby molten steel is subjected to a vacuum in order to remove gaseous impurities. It is advantageous to remove hydrogen, nitrogen, and oxygen from the molten steel as these gases can impart undesirable qualities to certain grades of steel. The vacuum is most commonly produced through the use of steam ejectors. The venturi action of the steam in the ejector throat and the condensation of the steam combine to produce the vaccum. The particle laden steam coming from the steam ejectors is condensed in barometric condensers, thus producing a wastewater which requires treatment.

The industry uses various types of degassers and degasses steels containing a variety of different components. However, the Agency has determined these variations do not affect the quantity or quality of wastewaters produced in the vacuum degassing operations to the extent that further subdivision of this subcategory is warranted.

## Subcategory F: Continuous Casting

The continuous casting process is used to produce semi-finished steel directly from molten steel. The molten steel from the steelmaking operation is ladeled into a tundish from where it is continuously cast into water cooled copper molds of the desired shapes. After leaving the copper mold, the semi-solidified steel is sprayed with water for further cooling solidifications. In addition to cooling, the water sprays also serve to remove scale and other impurities from the steel surface. The water that directly cools the steel and guide rollers contains particulates and roller lubricating oils, and must be treated prior to discharge.

Although there are three types of continuous casters in use, they only differ in physical orientation. When the Agency analyzed these and other factors relating to the continuous casting subcategory, it found no significant variations in the quantity or quality of wastewaters generated. Therefore, the Agency determined that further subdivision of the Continuous Casting subcategory is not appropriate.

Subcategory G: Hot Forming

Hot forming is the steel forming process in which hot steel is transformed in size and shape through a series of forming steps to ultimately produce semi-finished and finished steel products. Feed materials may be ingots, continuous caster billets, or blooms and slabs from primary hot forming mills (as feed to hot forming section or hot forming flat mills). The steel products consist of many types of cross-sections, sizes and lengths. Four different types of hot forming mills are used to produce the many types of hot formed steel products. The four types of mills (primary, section, flat, and pipe and tube) are the bases for the principal subdivisions of the Hot Forming subcategory. Variations in flow rates and configurations among these subdivisions were the most important factors in making these subdivisions. The Agency found that further segmentation is necessary to reflect variations due to product shape, type of steel, and process used.

Wastewaters result from several sources in hot forming operations. The hot steel is reduced in size by a number of rolling steps where contact cooling water is continuously sprayed over the rolls and hot steel product to cool the steel rolls and the flush away scale as it is broken off from the surface. Scarfing is used at some mills to remove imperfections in order to improve the quality of steel surfaces. Scarfing generates large quantities of fume, smoke, and waste gases which require scrubbing. Scrubbing of these fumes generates additional wastewater.

The Agency found variations in the quantity of wastewaters generated in the four subdivisions of the Hot Forming subcategory. The quality and treatability of hot forming wastewaters is not significantly different.

The Primary mill subdivision has been split into two segments: (1) carbon and specialty mills without scarfing, and (2) carbon and specialty mills with scarfing. The use of scarfing equipment results in an additional applied process flow of 1100 gal/ton.

The Section mill subdivision has also been separated into two segments, carbon and specialty steels. On the average, 1900 gal/ton more water is used on carbon section mills. For this reason, the Agency determined that it is appropriate to further divide the section mill subdivision into carbon and specialty mill segments.

The Flat mill subdivision has been split into three segments: (1) hot strip and sheet (both carbon and specialty), (2) plate (carbon) and (3) plate (specialty). As with section mills, carbon and specialty plate operations differ significantly in several areas. About 1900 gal/ton more water is used in carbon flat plate operations than in specialty flat plate operations. Also, carbon plate mills are about three times as large as specialty plate mills. While no differences were noted between carbon and specialty hot strip and sheet operations, hot strip operations in general require 3900 gal/ton more water than do plate operations. That difference resulted in the hot strip and sheet segment in the hot forming flat subdivision.

TH;w;We Agency determined that the distinction between isolated and integrated operations in the Hot Worked Pipe and Tube subdivision made in the prior regulation is not appropriate. This former segment was deleted.

Subcategory H: Salt Bath Descaling

Salt bath descaling is the operation in which specialty steel products are processed in molten salt solutions for scale removal. Two types of scale removal operations are in use: oxidizing and reducing. The oxidizing process uses highly oxidizing salt baths which react far more aggressively with the scale than with base metal. This chemical action causes surface scale to crack so that subsequent pickling operations are more effective in removing the scale. Reducing baths depend upon the strong reducing properties of sodium hydride to accomplish the same purpose. During that operation most scale forming oxides are reduced to base metal.

Flow rates and wastewater characteristics differ between the two types of operations. Wastewaters from reducing operations can contain quantities of cyanide not contained in wastewaters from oxidizing operations. Wastewaters from oxidizing operations contain large amounts of hexavalent chromium, which are not usually found in reducing bath wastewaters. In order to develop effluent limitations that would adequately reflect these variations, the Agency determined that subdivision of the scale removal subcategory into oxidizing and reducing operations is appropriate.

The Agency has also concluded that the method of operation, i.e., batch or continuous, significantly affects water use requirements. Hence, it has segmented both subdivisions. In addition, because of variations in water use rates, related to the type of product being processed in batch oxidizing operations, the Agency has segmented this subdivision further to reflect these differences.

Subcategory I: Acid Pickling

Acid pickling is the process of chemically removing oxides and scale from the surface of the steel by the action of water solutions of inorganic acids. The three major wastewater sources associated with acid pickling operations are spent pickle liquor, rinse waters, and the water used to scrub acid vapors and mists. These wastewaters contain free acids and ferrous salts in addition to other organic and inorganic impurities. Most carbon steels are pickled in sulfuric or hydrochloric acids. Most stainless and alloy steels are pickled in a mixture of nitric and hydrofluoric acids. Since wastewater characteristics are dependent on the acid used, the Agency has established three primary subdivisions of this subcategory; i.e., sulfuric, hydrochloric, and combination acid pickling operations.

The Agency has concluded that, within each of the three acid pickling subdivisions, further segmentation, primarily on the basis of product type rather than on wastewater source or treatment technique, is appropriate. Additionally, segments have been established in each subdivision to separately limit the discharges from scrubbers.

The Sulfuric Acid Pickling subdivision has been further separated into five segments, four of which reflect the different water use rates associated with product groupings and one reflective of the water use rate in fume scrubbers. Since water use in a fume scrubber is not related to the tonnage of product pickled, limitations and standards for this segment have been established on the basis of kg/day rather than kg/kkg of product.

The Hydrochloric Acid Pickling subdivision was further separated into five segments, three of which reflect the different water use rates associated with product groupings, and the other two reflective of water use rates on fume scrubbers. In this subdivision, scrubbers are used for fume collection over the pickling baths and for fume collection at the acid regeneration plant absorber vents. The differences in water use rates are reflected in the further segmentation. Limitations and standards in both fume scrubber segments are established on the basis of kg/day.

The Combination Acid Pickling subdivision was further separated into six segments, five of which reflect the different water use rates associated with product groupings, and the other based upon the water use rate in fume scrubbers. As above, limitations and standards in the fume scrubber segment have been established on the basis of kg/day.

### Subcategory J: Cold Forming

The Cold Forming subcategory is separated into two subdivisions: Cold Rolling and Cold Worked Pipe and Tube. The Agency concluded that subdivision is appropriate because of the differences in equipment used to form flat sheets and tubular shapes, and because of differences in rolling solution characteristics, wastewater flow rates and treatment and disposal methods.

Cold rolling is used to reduce the thickness of a steel product, which produces a smooth dense surface and develops controlled mechanical properties in the metal. An oil-water emulsion lubricant is sprayed on the material as it enters the work rolls of a cold rolling mill, and the material is usually coated with oil prior to recoiling after it has passed through the mill. The oil prevents rust while the material is in transit or in storage. It must be removed before the material can be further processed or formed. Oil from the oil water emulsion lubricant is the major pollutant load in wastewaters resulting from this operation.

In the Cold Rolling subdivision three methods of oil application are used. The methods are direct application, recirculation, and combinations of the two. Because recycle rate is dependent upon the oil application system, flow rates vary for the three systems. These differences in flow rates make further segmentation of the Cold Rolling subdivision appropriate. Within the recirculation and direct application segments, the number of rolling stands used affects the water use rate. This is reflected in separate limitations within these segments based upon whether a mill has a single stand or whether the mill has multiple stands.

In the Pipe and Tube subdivision of the Cold Forming subcategory, cold flat steel strips are formed into hollow cylindrical products. Wastewaters are generated as a result of continuous flushing with water or soluble oil lubricating solutions, resulting in significant differences in the quantity and quality of wastewaters generated by these methods. Therefore, the Agency determined that further separation of the Pipe and Tube subdivision into water type operations and oil solution type operations, is warranted.

### Subcategory K: Alkaline Cleaning

Alkaline cleaning baths are used to remove mineral and animal fats and oils from steel. The cleaning baths used are not very aggressive and therefore do not generate many pollutants. The alkaline cleaning solution is usually a dispersion of chemicals such as carbonates, alkaline silicates, and phosphates in water. The cleaning bath itself and the rinse water used are the two sources of wastewaters in the alkaline cleaning process. Both continuous and batch operations are used by the industry. The Agency, after further review of available wastewater flow data, has concluded that significant differences in the quantity of wastewaters generated at batch and continuous operations should be reflected in the limitations and standards for alkaline cleaning operations. Therefore, the Alkaline Cleaning subcategory has been subdivided into batch and continuous operations.

### Subcategory L: Hot Coating

Hot coating processes involve the immersion of clean steel into baths of molten metal for the purpose of depositing a thin layer of the metal onto the steel surface. These metal coatings can impart such desirable qualities as corrosion resistance or a decorative appearance to the steel. Hot coating processes can be carried out in continuous or batch operations. The physical configuration of the product being coated usually determines the method of coating to be used.

The Hot Coating subcategory has been divided into three subdivisions based upon the type of coating used. Galvanizing is a zinc coating operation. Terne coating consists of a lead and tin coating of five or six parts lead to one part tin. Other metal coatings can include aluminum, hot dipped tin, or mixtures of these and other metals. These operations generate different polutants due to the variety of metals used.

However, the control technologies, except for hexavalent chromium reduction required for galvanizing lines with chromate passivating dips, are the same for all hot coating operations. The lime precipitation and clarification process will adequately control each of the toxic metals. There is a considerable difference in the water use rates based upon the type of product coated. Therefore the Agency has concluded that further separation of the galvanizing, and terne and other coatings subdivisions into two segments based upon product type is warranted. These segments are the strip, sheet, and miscellaneous products segment and the wire product and fasteners segment. The Agency has also provided a segment for fume scrubbers applicable to any hot coating operation with fume scrubbers.

# VOLUME I

# SECTION V

# SELECTION OF REGULATED POLLUTANTS

## Introduction

Three types of pollutants were considered for regulation in the steel industry: conventional pollutants, nonconventional pollutants, and toxic pollutants. To determine the presence and level of these pollutants in steel industry wastewaters, the Agency conducted extensive monitoring at several representative plants in the industry. Average wastewater concentrations of each pollutant were determined for each subcategory. These concentrations, in conjunction with the waste loading, formed the basis for determining whether a particular pollutant was considered for regulation.

## Development of Regulated Pollutants

The concentration data were reviewed for 141 pollutants; 130 toxic, 8 nontoxic nonconventional, and 3 conventional. These values ranged from "not detected" to 71,000 mg/l (ppm). The concentration values were reviewed and each pollutant was assigned to one of four categories.

1. Not Detected - Reserved for any pollutant which was not detected during industry-wide plant sampling.

2. Environmentally Insignificant - Pollutants detected at levels of 0.010 mg/l (10 ppb) or less in industry-wide sampling; or, pollutants not normally occurring in wastewaters from these sources.

3. Not Treatable - Pollutants detected at levels greater than 10 ppb but at levels below the treatability level determined for that pollutant.

4. Regulation Considered - Any pollutant detected at a level greater than the corresponding treatability level was considered for regulation.

The results of the categorization are presented in Table V-1. Of the 141 pollutants initially considered, 60 (50 toxics and 10 others) have been considered for regulation. In order to further analyze the source of these pollutants, their presence by subcategory was tabulated. Table V-2 lists pollutants appearing in the twelve subcategories at levels greater than treatability. The physical properties, toxic effects in humans and aquatic life, and behavior in POTWs of these 60 pollutants are discussed in Appendix D to this document. In compiling this material, particular weight was given to

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documents generated by the Criteria and Standards, and Monitoring and Data Support Divisions of EPA.

## Regulated Pollutants

Most of the toxic pollutants (29) are found in two subcategories: Cold Forming and Cokemaking. In order to avoid costly analytical work, four organic pollutants (benzene, naphthalene, benzo-a-pyrene and tetrachloroethylene) are limited and serve as indicator pollutants. Other toxic pollutants known to be present in wastewaters in significcant quantities are also limited.

The list of pollutants directly limited by the regulation is found in Table V-3. This list consists of 16 pollutants; 9 toxic, 4 nontoxic nonconventional, and 3 conventional. Table V-4 lists the pollutants limited in each subcategory.

## TABLE V-1

## DEVELOPMENT OF REGULATED POLLUTANT LIST
## IRON & STEEL INDUSTRY

| No. | Pollutant | Not Detected | Environmentally Insignificant(1) | Not Treatable(2) | Regulation Considered |
|---|---|---|---|---|---|
| 001 | Acenaphthene | - | - | - | X |
| 002 | Acrolein | X | - | - | - |
| 003 | Acrylonitrile | - | - | - | X |
| 004 | Benzene | - | - | - | X |
| 005 | Benzidine | X | - | - | - |
| 006 | Carbon tetrachloride | - | - | - | X |
| 007 | Chlorobenzene | X | - | - | - |
| 008 | 1,2,4-trichlorobenzene | X | - | - | - |
| 009 | Hexachlorobenzene | - | - | X | - |
| 010 | 1,2-dichloroethane | - | - | X | - |
| 011 | 1,1,1-trichloroethane | - | - | - | X |
| 012 | Hexachlorethane | X | - | - | - |
| 013 | 1,1-dichloroethane | - | - | - | X |
| 014 | 1,1,2-trichloroethane | - | X | - | - |
| 015 | 1,1,2,2-tetrachloroethane | - | - | X | - |
| 016 | Chloroethane | X | - | - | - |
| 017 | bis(chloromethyl)ether | X | - | - | - |
| 018 | bis(2-chloroethyl)ether | X | - | - | - |
| 019 | 2-chloroethyl vinyl ether | X | - | - | - |
| 020 | 2-chloronaphthalene | - | - | X | - |
| 021 | 2,4,6-trichlorophenol | - | - | - | X |
| 022 | Parachlorometacresol | - | - | - | X |
| 023 | Chloroform | - | - | - | X |
| 024 | 2-chlorophenol | - | - | X | - |
| 025 | 1,2-dichlorobenzene | - | - | X | - |
| 026 | 1,3-dichlorobenzene | X | - | - | - |
| 027 | 1,4-dichlorobenzene | - | - | X | - |
| 028 | 3,3'-dichlorobenzidine | X | - | - | - |
| 029 | 1,1-dichloroethylene | - | X | - | - |
| 030 | 1,2-trans-dichloroethylene | - | - | X | - |
| 031 | 2,4-dichlorophenol | - | - | X | - |
| 032 | 1,2-dichloropropane | X | - | - | - |
| 033 | 1,2-dichloropropylene | X | - | - | - |
| 034 | 2,4-dimethyl phenol | - | - | - | X |
| 035 | 2,4-dinitrotoluene | - | - | - | X |
| 036 | 2,6-dinitrotoluene | - | - | - | X |
| 037 | 1,2-diphenylhydrazine | - | - | X | - |
| 038 | Ethylbenzene | - | - | - | X |
| 039 | Fluoranthene | - | - | - | X |
| 040 | 4-chlorophenyl phenyl ether | X | - | - | - |
| 041 | 4-bromophenyl phenyl ether | X | - | - | - |
| 042 | bis(2-chloroisopropyl) ether | X | - | - | - |
| 043 | bis(2-chloroethoxy) methane | X | - | - | - |
| 044 | Methylene chloride | - | - | X | - |

TABLE V-1
DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY
PAGE 2

| No. | Pollutant | Not Detected | Environmentally Insignificant(1) | Not Treatable(2) | Regulation Considered |
|---|---|---|---|---|---|
| 045 | Methyl chloride | X | - | - | - |
| 046 | Methyl bromide | X | - | - | - |
| 047 | Bromoform | X | - | - | - |
| 048 | Dichlorobromomethane | - | - | X | - |
| 049 | Trichlorofluoromethane | X | - | - | - |
| 050 | Dichlorodifluoromethane | X | - | - | - |
| 051 | Chlorodibromomethane | X | - | - | - |
| 052 | Hexachlorobutadiene | X | - | - | - |
| 053 | Hexachlorocyclopentadiene | X | - | - | - |
| 054 | Isophorone | - | - | X | - |
| 055 | Naphthalene | - | - | - | X |
| 056 | Nitrobenzene | - | - | X | - |
| 057 | 2-nitrophenol | - | - | X | - |
| 058 | 4-nitrophenol | - | - | - | X |
| 059 | 2,4-dinitrophenol | - | - | X | - |
| 060 | 4,6-dinitro-o-cresol | - | - | - | X |
| 061 | N-nitrosodimethylamine | X | - | - | - |
| 062 | N-nitrosodiphenylamine | X | - | - | - |
| 063 | N-nitrosodi-n-propylamine | X | - | - | - |
| 064 | Pentachlorophenol | - | - | - | X |
| 065 | Phenol | - | - | - | X |
| 066 | bis(2-ethylhexyl)phthalate | - | - | - | X |
| 067 | Butyl benzyl phthalate | - | - | - | X |
| 068 | Di-n-butyl phthalate | - | - | - | X |
| 069 | Di-n-octyl phthalate | - | - | - | X |
| 070 | Diethyl phthalate | - | - | - | X |
| 071 | Dimethyl phthalate | - | - | - | X |
| 072 | Benzo(a)anthracene | - | - | - | X |
| 073 | Benzo(a)pyrene | - | - | - | X |
| 074 | 3,4-benzofluoranthene | - | X | - | - |
| 075 | Benzo(k)fluoranthene | - | X | - | - |
| 076 | Chrysene | - | - | - | X |
| 077 | Acenaphthylene | - | - | - | X |
| 078 | Anthracene | - | - | - | X |
| 079 | benzo(ghi)perylene | - | X | - | - |
| 080 | Fluorene | - | - | - | X |
| 081 | Phenathrene | - | - | - | X |
| 082 | Dibenzo(a,h)anthracene | - | X | - | - |
| 083 | Indeno(1,2,3,cd)pyrene | - | X | - | - |
| 084 | Pyrene | - | - | - | X |
| 085 | Tetrachloroethylene | - | - | - | X |
| 086 | Toluene | - | - | - | X |
| 087 | Trichlorethylene | - | - | - | X |
| 088 | Vinyl chloride | - | X | - | - |
| 089 | Aldrin | - | X | - | - |

TABLE V-1
DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY
PAGE 3

| No. | Pollutant | Not Detected | Environmentally Insignificant(1) | Not Treatable(2) | Regulation Considered |
|---|---|---|---|---|---|
| 090 | Dieldrin | - | X | - | - |
| 091 | Chlordane | - | X | - | - |
| 092 | 4,4'-DDT | - | X | - | - |
| 093 | 4,4'-DDE | - | X | - | - |
| 094 | 4,4'-DDD | - | X | - | - |
| 095 | a-endosulfan-Alpha | - | X | - | - |
| 096 | b-endosulfan-Beta | - | X | - | - |
| 097 | Endosulfan sulfate | - | X | - | - |
| 098 | Endrin | - | X | - | - |
| 099 | Endrin aldehyde | - | X | - | - |
| 100 | Heptachlor | - | X | - | - |
| 101 | Heptachlor epoxide | - | X | - | - |
| 102 | a-BHC-Alpha | - | X | - | - |
| 103 | b-BHC-Beta | - | X | - | - |
| 104 | r-BHC-Gamma | - | X | - | - |
| 105 | g-BHC-Delta | - | X | - | - |
| 106 | PCB-1242 | - | X | - | - |
| 107 | PCB-1254 | - | X | - | - |
| 108 | PCB-1221 | - | X | - | - |
| 109 | PCB-1232 | - | X | - | - |
| 110 | PCB-1248 | - | X | - | - |
| 111 | PCB-1260 | - | X | - | - |
| 112 | PCB-1016 | - | X | - | - |
| 113 | Toxaphene | - | X | - | - |
| 114 | Antimony | - | - | - | X |
| 115 | Arsenic | - | - | - | X |
| 116 | Asbestos | - | X | - | - |
| 117 | Beryllium | - | - | X | - |
| 118 | Cadmium | - | - | - | X |
| 119 | Chromium | - | - | - | X |
| 120 | Copper | - | - | - | X |
| 121 | Cyanide | - | - | - | X |
| 122 | Lead | - | - | - | X |
| 123 | Mercury | - | - | X | - |
| 124 | Nickel | - | - | - | X |
| 125 | Selenium | - | - | - | X |
| 126 | Silver | - | - | - | X |
| 127 | Thallium | - | - | - | X |
| 128 | Zinc | - | - | - | X |
| 129 | 2,3,7,8-tetrachlordibenzo-p-dioxin | X | - | - | - |
| 130 | Xylene | - | - | - | X |

TABLE V-1
DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY
PAGE 4

| No. | Pollutant | Not Detected | Environmentally Insignificant (1) | Not Treatable (2) | Regulation Considered |
|---|---|---|---|---|---|
| | Aluminum | - | - | - | X |
| | Ammonia | - | - | - | X |
| | Dissolved Iron | - | - | - | X |
| | Fluoride | - | - | - | X |
| | Hexavalent Chromium | - | - | - | X |
| | Manganese | - | - | - | X |
| | Oil and Grease | - | - | - | X |
| | pH | - | - | - | X |
| | Phenol (4AAP) | - | - | - | X |
| | Chlorine Residual | - | - | - | X |
| | Total Suspended Solids | - | - | - | X |

---

X: Indicates heading which applies to pollutant.
-: Indicates heading which does not apply to pollutant.

(1) Pollutants detected at levels of 0.01 mg/l or less for pollutants not normally occuring in wastewater from these sources.
(2) Concentration of pollutant found at levels below treatability. However, pollutant load could be reduced by recycle.

TABLE V-2

POLLUTANTS CONSIDERED FOR REGULATION BY SUBCATEGORY
IRON & STEEL INDUSTRY

| No. | Pollutant | Coke-making | Sintering | Iron-making | Steel-making | Vacuum Degassing | Continuous Casting | Hot Forming | Salt Bath Descaling | Acid Pickling | Cold Forming | Alkaline Cleaning | Hot Coatings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Acenaphthene | - | - | - | - | - | - | - | - | - | X | - | - |
| 3 | Acrylonitrile | X | - | - | - | - | - | - | - | - | - | - | - |
| 4 | Benzene | X | - | - | - | - | - | - | - | - | - | - | - |
| 6 | Carbon Tetrachloride | - | - | - | - | - | - | - | - | - | X | - | - |
| 9 | Hexachlorobenzene | - | - | X | - | - | - | - | - | - | - | - | - |
| 11 | 1,1,1-trichloroethane | - | - | - | - | - | - | - | - | - | X | - | - |
| 13 | 1,1-dichloroethane | - | - | - | - | - | - | - | - | - | X | - | - |
| 21 | 2,4,6-trichlorophenol | X | - | - | - | - | - | - | - | - | - | - | - |
| 22 | Parachlorometacresol | X | - | - | - | - | - | - | - | - | - | - | - |
| 23 | Chloroform | X | - | - | X | - | - | - | X | - | X | - | - |
| 24 | 2-chlorophenol | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | 2,4-Dichlorophenol | - | - | X | - | - | - | - | - | - | - | - | - |
| 34 | 2,4-dimethylphenol | X | - | X | - | - | - | - | - | - | - | - | - |
| 35 | 2,4-dinitrotoluene | X | - | - | - | - | - | - | - | - | - | - | - |
| 36 | 2,6-dinitrotoluene | X | - | - | - | - | - | - | - | - | - | X | - |
| 38 | Ethylbenzene | X | - | - | - | - | - | - | - | - | - | - | - |
| 39 | Fluoranthene | X | X | X | X | - | - | - | - | - | X | X | - |
| 54 | Isophorone | X | - | - | - | - | - | - | - | - | - | - | - |
| 55 | Naphthalene | X | - | - | - | - | - | - | - | - | X | - | - |
| 58 | 4-Nitrophenol | - | - | - | X | - | - | - | - | - | - | - | - |
| 60 | 4,6-dinitro-o-cresol | X | - | - | - | - | - | - | - | - | X | - | - |
| 64 | Pentachlorophenol | X | - | - | X | - | - | - | - | - | - | - | - |
| 65 | Phenol | X | X | X | - | - | - | - | - | - | X | - | - |
| 66 | - | | | | | | | | | | | | |
| 71 | Phthalates, total | X | - | - | - | - | - | - | - | - | - | - | - |
| 72 | Benzo(a)anthracene | X | - | - | - | - | - | - | - | - | X | - | - |
| 73 | Benzo(a)pyrene | X | - | X | - | - | - | - | - | - | - | - | - |
| 76 | Chrysene | X | X | X | - | - | - | - | - | - | X | - | - |
| 77 | Acenaphthylene | X | - | - | - | - | - | - | - | - | X | - | - |
| 78 | Anthracene | - | - | - | - | - | - | - | - | - | X | - | - |
| 80 | Fluorene | X | - | - | - | - | - | - | - | - | X | - | - |
| 81 | Phenanthrene | - | - | - | - | - | - | - | - | - | X | - | - |
| 84 | Pyrene | X | X | X | - | - | - | - | - | - | X | X | - |
| 85 | Tetrachloroethylene | - | - | - | - | - | - | - | - | - | X | - | - |
| 86 | Toluene | X | - | - | - | - | - | - | - | - | X | - | - |
| 87 | Trichloroethylene | - | - | - | - | - | - | - | - | - | X | - | - |

TABLE V-2
POLLUTANTS CONSIDERED FOR REGULATION BY SUBCATEGORY
IRON & STEEL INDUSTRY
PAGE 2

| No. | Pollutant | Coke-making | Sintering | Iron-making | Steel-making | Vacuum Degassing | Continuous Casting | Hot Forming | Salt Bath Descaling | Acid Pickling | Cold Forming | Alkaline Cleaning | Hot Coatings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 114 | Antimony | X | - | X | X | - | - | - | X | X | X | X | - |
| 115 | Arsenic | X | - | X | X | - | - | - | X | X | X | - | X |
| 118 | Cadmium | - | X | X | X | - | - | - | X | X | X | - | X |
| 119 | Chromium | - | X | X | X | X | X | X | X | X | X | X | X |
| 120 | Copper | - | X | X | X | X | X | X | X | X | X | X | X |
| 121 | Cyanide | X | X | X | - | - | - | - | X | - | - | X | - |
| 122 | Lead | - | X | X | X | X | X | X | X | X | X | X | X |
| 124 | Nickel | - | X | X | X | X | - | X | X | X | X | X | X |
| 125 | Selenium | X | - | X | X | - | X | - | X | - | - | X | - |
| 126 | Silver | - | - | - | X | - | - | - | X | X | - | - | - |
| 127 | Thallium | - | - | - | X | - | - | - | X | - | - | - | - |
| 128 | Zinc | X | X | X | X | X | X | X | X | X | X | X | X |
| 130 | Xylene | X | - | - | - | - | - | - | - | - | - | - | - |
| | Aluminum | - | - | - | - | - | - | - | - | - | - | - | X |
| | Ammonia | X | - | X | - | - | - | - | - | - | - | - | - |
| | Dissolved Iron | - | - | - | - | - | - | - | X | X | X | X | X |
| | Fluoride | - | X | X | X | - | - | - | - | X | - | - | - |
| | Hexavalent Chromium | - | - | - | - | - | - | - | X | - | - | - | - |
| | Manganese | - | - | - | - | X | - | - | - | - | - | - | - |
| | Oil and Grease | X | X | - | - | - | X | X | - | X | X | X | X |
| | pH | X | X | X | X | X | X | X | X | X | X | X | X |
| | Phenolic Compounds | X | X | X | - | - | - | - | - | - | - | - | - |
| | TRC | - | X | X | - | - | - | - | - | - | - | - | - |
| | Total Suspended Solids | X | X | X | X | X | X | X | X | X | X | X | X |

---

X: Selected for consideration in development of regulated pollutant list in this subcategory.
-: Not selected for consideration in development of regulated pollutant list in this subcategory.

## TABLE V-3

## REGULATED POLLUTANT LIST
## IRON & STEEL INDUSTRY

| | |
|---|---|
| 4 | Benzene |
| 55 | Naphthalene |
| 73 | Benzo(a)pyrene |
| 85 | Tetrachloroethylene |
| 119 | Chromium |
| 121 | Cyanide |
| 122 | Lead |
| 124 | Nickel |
| 128 | Zinc |

Ammonia
Oil & Grease
pH
Phenol (4AAP)
Chlorine Residual
Total Suspended Solids
Hexavalent Chromium

TABLE V-4

REGULATED POLLUTANT LIST BY SUBCATEGORY
IRON & STEEL INDUSTRY

| No. | Pollutant | Cokemaking | Sintering | Ironmaking | Basic Oxygen Furnace (Steelmaking) | Open Hearth Furnace (Steelmaking) | Electric Arc Furnace (Steelmaking) | Vacuum Degassing | Continuous Casting | Hot Forming |
|---|---|---|---|---|---|---|---|---|---|---|
| 004 | Benzene | X | - | - | - | - | - | - | - | - |
| 055 | Naphthalene | X | - | - | - | - | - | - | - | - |
| 073 | Benzo(a)pyrene | X | - | - | - | - | - | - | - | - |
| 085 | Tetrachloroethylene | - | - | - | - | - | - | - | - | - |
| 119 | Chromium | - | - | - | - | - | - | - | - | - |
| 121 | Cyanide | X | X | X | - | - | - | - | - | - |
| 122 | Lead | - | X | X | X | X | X | X | X | - |
| 124 | Nickel | - | - | - | - | - | - | - | - | - |
| 128 | Zinc | - | X | X | X | X | X | X | X | - |
| | Ammonia | X | X | X | - | - | - | - | - | - |
| | Fluoride | - | - | - | - | - | - | - | - | - |
| | Oil & Grease | X | X | X | - | - | - | - | X | X |
| | pH | X | X | X | X | X | X | X | X | X |
| | Phenol (4AAP) | X | X | X | - | - | - | - | - | - |
| | Chlorine (Residual) | - | X | X | - | - | - | - | - | - |
| | Total Suspended Solids | X | X | X | X | X | X | X | X | X |
| | Hexavalent Chromium | - | - | - | - | - | - | - | - | - |

TABLE V-4
REGULATED POLLUTANT LIST BY SUBCATEGORY
IRON & STEEL INDUSTRY
PAGE 2

| No. | Pollutant | Salt Bath Descaling (Oxidizing) | Salt Bath Descaling (Reducing) | Sulfuric Acid Pickling | Hydrochloric Acid Pickling | Combination Acid Pickling | Cold Rolling | Alkaline Cleaning | Hot Coating |
|---|---|---|---|---|---|---|---|---|---|
| 004 | Benzene | - | - | - | - | - | - | - | - |
| 055 | Naphthalene | - | - | - | - | - | X | - | - |
| 073 | Benzo(a)pyrene | - | - | - | - | - | - | - | - |
| 085 | Tetrachloroethylene | - | - | - | - | - | X | - | - |
| 119 | Chromium | X | X | - | - | X | X | - | - |
| 121 | Cyanide | - | X | - | - | - | - | - | - |
| 122 | Lead | - | - | X | X | - | X | - | X |
| 124 | Nickel | X | X | - | - | X | X | - | - |
| 128 | Zinc | - | - | X | X | - | X | - | X |
| | Ammonia | - | - | - | - | - | - | - | - |
| | Fluoride | - | - | - | - | - | - | - | - |
| | Oil & Grease | - | - | X | X | X | X | X | X |
| | pH | X | X | X | X | X | X | X | X |
| | Phenol (4AAP) | - | - | - | - | - | - | - | - |
| | Chlorine Residual | - | - | - | - | - | - | - | - |
| | Total Suspended Solids | X | X | X | X | X | X | X | X |
| | Hexavalent Chromium | - | - | - | - | - | - | - | X |

---

X: Selected for regulation in this subcategory.
-: Not selected for regulation in this subcategory.

# VOLUME I

# SECTION VI

# WATER POLLUTION CONTROL AND TREATMENT TECHNOLOGY

## A. Introduction

This section describes in-plant and end-of-pipe wastewater treatment technologies currently in use or available for use in the steel industry. The technology descriptions are grouped as follows: recycle; suspended solids removal; oil removal; toxic metal pollutant removal; toxic organic pollutant removal; advanced technologies; and, zero discharge technologies. The application and performance; advantages and limitations; reliability; maintainability; and demonstration status of each technology are presented. The treatment processes include both technologies presently demonstrated within the steel industry, and those demonstrated in other industries with similar wastewaters.

## B. End of Pipe Treatment

### Recycle Systems

Recycle is both an in-plant and end of pipe treatment operation used to reduce the volume of wastewater discharged. Wastewater reuse reduces the discharge flow and the pollutant load discharged from the process.

### Application and Performance

Recycle is included in the model treatment systems for nine of the twelve steel industry subcategories. The Agency estimates that the use of these recycle systems can result in a 68.5% reduction in process water discharges at the BPT level and a 69% reduction at the BAT level. To achieve these reductions, high degrees of recycle demonstrated in the industry have been included in model treatment systems as shown below:

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| Subcategory | BAT Recycle Rate (%) |
|---|---|
| Cokemaking (Barometric Condenser) | 95 |
| Sintering | 92 |
| Ironmaking | 98 |
| Steelmaking | 96-100 |
| Vacuum Degassing | 98 |
| Continuous Casting | 99 |
| Hot Forming | 60-77 |
| Acid Pickling (fume scrubber) | 95-98 |
| Hot Coating (fume scrubber) | 85 |

Higher rates of recycle are demonstrated in these and other subcategories. For example, rates of recycle up to 99% are common for hot forming operations.

At high recycle rates, two problems can be encountered. First, if the wastewater is contaminated, a build-up of dissolved solids in the recycled water can cause plugging and corrosion. This problem can be avoided by providing sufficient treatment of the wastewater prior to recycle, by adding chemicals that inhibit scaling or corrosion, and by having sufficient blowdown to limit the build-up of dissolved solids and other pollutants. The second problem that can occur is excessive heat build-up in the recycled water. If the temperature of the water to be recycled is too high for its intended purpose, it must be cooled prior to recycle. The most common method of reducing the heat load of recycled water in the steel industry is with mechanical draft cooling towers. Mechanical draft evaporative cooling systems are capable of handling the wide range of operating conditions encountered in the steel industry. Cooling towers are included in the model treatment systems for four of the eight subcategories (cokemaking final cooler and barometric condenser recycle systems, ironmaking, vacuum degassing, and continuous casting) where recycle systems are considered. Heat accumulation in the other subcategory recycle systems is not detrimental to the operation.

## Advantages and Limitations

As discussed above, recycle systems can achieve significant pollutant load reductions at relatively low cost. The system is controlled by simple instrumentation and relatively little operator attention is required.

A potential limitation on the use of recycle systems is plugging and scaling. However, based upon the industry's response to basic and detailed questionnaires, the Agency believes that with proper attention and maintenance, plugging and scaling should not present a significant problem with achieving the recycle rates used as a basis for this regulation.

## Operational Factors

1. Reliability

   The reliability of recycle systems is high, although proper monitoring and control are required for high rate systems. Chemical aids are often used in the recycle loops to maintain optimum operating conditions.

2. Maintainability

   Most recycle systems include only simple pump stations and piping. These components require very little attention aside from routine maintenance. However, for those recycle systems associated with wet air pollution control devices, higher maintenance costs are incurred to chemically control the recycled water to remove suspended and dissolved constituents and to prevent fouling and scaling.

## Demonstration Status

Recycle systems are well demonstrated in the steel industry as well as in numerous other industral applications. Full scale recycle systems have been used in the steel industry for many years. The recycle rates used to develop effluent limitations and standards for each subcategory are demonstrated on a full scale basis in the industry.

## Suspended Solids Removal

Many types of suspended solids removal devices are in use in the steel industry including clarifiers, thickeners, inclined plate separators, settling lagoons, and filtration (mixed or single media; pressure or gravity). Three broad categories that encompass virtually all methods of suspended solids removal are reviewed: (1) settling lagoons, (2) clarification which includes clarifiers, thickeners, and inclined plate separators and (3) filtration.

1. Settling Lagoon (or Basin)

   Settling (sedimentation) is a process which removes solid particles from a liquid matrix by gravitational force. The operation reduces the velocity of the wastewater stream in a large volume tank or lagoon so that gravitational settling can occur. Because of the large wastewater volumes involved in the steel industry, lagoons are generally large, on the order of 0.1 to 10 acres of surface area, typically with a standard working depth of 7 to 10 feet. The industry has found lagoons up to 400 acres.

   Long retention times are generally required for sedimentation. Accumulated sludge is removed either periodically or continuously and either manually or mechanically. But because simple sedimentation may require an excessively large settling area, and because high retention times (days as compared with hours) are usually required to effectively treat the wastewater, the addition of settling aids such as alum or polymeric flocculants is often used.

Sedimentation is often preceded by chemical precipitation and coagulation. Chemical precipitation converts dissolved pollutants to solid form, while coagulation enhances settling by gathering together suspended precipitates into larger, faster settling particles.

## Application and Performance

Settling lagoons are used to treat wastewaters from all steel industry subcategories. Most are terminal treatment lagoons which serve as a final treatment step prior to discharge. Often these lagoons are a main component in central treatment systems and are used to settle out suspended solids from several process waste streams.

A properly operated sedimentation system is capable of efficiently removing suspended solids (including metal hydroxides), and other impurities from wastewaters. The performance of the lagoon depends primarily on overflow rate and a variety of other factors, including the density and particle size of the solids, the effective charge of the suspended particles, and the types of chemicals used for pretreatment, if any.

## Advantages and Limitations

The major advantage of suspended solids removal by sedimentation is the simplicity of the process. The major problem with simple settling is the long retention time necessary to achieve a high degree of suspended solids removal, especially if the specific gravity of the suspended matter is close to that of water. Retention time is directly related to lagoon volume. Thus, long retention time means large area requirements not available at some steel plants. Another limitation is that dissolved or soluble pollutants are not removed by sedimentation.

## Operational Factors

a. Reliability: Sedimentation is a highly reliable technology for removing suspended solids. Sufficient retention time and regular sludge removal are important factors affecting the reliability of all settling systems. The proper control of pH, chemical precipitation, and coagulation or flocculation are additional factors which affect settling efficiencies.

b. Maintainability: Little maintenance is required for lagoons other than periodic sludge removal.

Demonstration Status

Based upon the survey of the industry through questionnaires and sampling surveys, the Agency estimates that there are over 140 settling lagoons in use at 39 steel plant sites. Hence, settling lagoons are well demonstrated in the steel industry.

### 2. Clarifiers

Clarifiers are another type of sedimentation device widely used in the steel industry. The chief benefits of clarifiers over lagoons are that clarifiers are less land intensive and provide for centralized sludge collection. Suspended SOlids removal efficiencies are generally in the same range as that for settling lagoons. Conventional clarifiers consist of a circular or rectangular tank with either a mechanical sludge collecting device or with a sloping funnel-shaped bottom designed for sludge collection. In alternative clarifier designs, inclined plates or tubes may be placed in the clarifier tank to increase the effective settling area and thus increase the capacity of the clarifier. As with settling lagoons, chemical aids are often added prior to clarification to enhance suspended solids removal.

Application and Performance

The application of clarification is very similar to that described above for settling lagoons. Clarifiers are used to treat wastewaters from every subcategory for suspended solids removal. Performance data are presented in Appendix A.

The Agency statistically analyzed long-term data for several clarification systems. The Agency calculated the mean, standard deviation and other common statistical values, as well as the 30-day average and daily maximum performance standards. A 30-day average concentration was calculated based upon a 95 percentile value while the daily maximum concentration was calculated with a 99 percentile value. The methods used to determine these values are explained in Appendix A.

Based upon the data presented above, and other data presented in the subcategory reports, the Agency concludes that a 30-day average concentration of 30 mg/l TSS and a daily maximum concentration of 70 mg/l TSS or less are attainable with clarifiers for most steel industry wastewaters. Biological treatment of cokemaking wastewaters produces low density suspended solids that are difficult to settle. Higher concentrations have been used in developing the limitations for this subcategory.

Advantages and Limitations

Clarification is more effective for removing suspended solids than simple settling lagoons, requires less area, and provides for centralized sludge collection. However, the cost of installing and maintaining clarifiers is greater than the costs associated with simple settling lagoons.

Inclined plate and slant tube settlers have removal efficiencies similar to conventional clarifiers, but have a greater capacity per unit area.

Operational Factors

a. Reliability: Similar to lagoon systems with proper control and maintenance. Clarifiers can achieve consistently low concentrations of solids and other pollutants in the wastewater.

   Those advanced clarifiers using slanted tubes or inclined plates may require prescreening of the wastewater in order to eliminate any materials which could potentially clog the system.

b. Maintainability: The systems used for chemical pretreatment and sludge dragout must be maintained on a regular basis. Routine maintenance of mechanical parts is also necessary.

Demonstration Status

Clarifiers are used extensively to treat wastewaters from all subcategories of the steel industry. While the design may vary slightly depending on the wastewaters being treated (i.e., steelmaking vs. pickling), all systems operate in a similar manner.

### 3. Filtration

Filtration is another common method used to remove suspended solids, oil and grease, and toxic metals from steel industry wastewaters. Several types of filters and filter media are used in the industry and all work by similar mechanisms. Filters may be pressure or gravity type; single, dual, or mixed media; and the media can be sand, diatomaceous earth, walnut shells or some other material.

A filter may use a single media such as sand. However, by using dual or mixed (multiple) media, higher flow rates and efficiencies can be achieved. The dual media filter usually consists of a fine bed of sand under a coarser bed of another media. The coarse media removes most of the influent solids, while the fine sand performs final polishing.

In the steel industry, several considerations are important when filter systems are designed. While either pressure or gravity systems may be used, the pressure systems are more common and provide some advantages, including smaller land area requirements.

For typical steel industry applications, filter rates are in the range of 6 gpm per square foot to perhaps 18 gpm per square foot. The efficiency of suspended solids removal is dependent upon the filtration rate, the filter media and the particle size. A knowledge of particle density, size distribution, and chemical composition is useful when selecting a filter design rate and media.

Filter media must be selected in conjunction with the filter design rate. The size and depth of the media is a primary consideration and other important factors are the chemical composition, sphericity, and hardness of the media chosen. The presence of relatively large amounts of oil in the wastewater to be filtered also affects the selection of the appropriate media.

During the filtration process, suspended solids and oils accumulate in the bed and reduce the ability of the wastewater to flow through the media. To function properly, all filters are backwashed. The method of backwashing and the design of backwash systems is an integral part of any deep-bed filtration system. Solids penetrate deeply into the bed and must be adequately removed during the backwashing cycle or problems may develop within the filtration system. Occasionally, auxiliary means are employed to aid filter cleaning. Water jets used just below the surface of the expanded bed will aid solids and oil removals. Also, air can be used to augment the cleaning action of the backwash water to "scour" the bed free of solids and oils.

Filter system operation may be manual or automatic. The filter backwash cycle may be on a timed basis, a pressure drop basis with a terminal value which triggers backwash, or on a suspended solids carryover basis from turbidity monitoring of the outlet stream. Each of these methods is well demonstrated.

## Application and Performance

In wastewater treatment plants, filters are often employed for final treatment following clarification, sedimentation or other similar operations. Filtration thus has potential application in nearly all industrial plants. Chemical additives which enhance the upstream treatment equipment may or may not be compatible with or enhance the filtration process. Normal operating flow rates for various types of filters are as follows:

| | |
|---|---|
| Slow Sand | 2.04-5.30 l/sq m/hr |
| Rapid Sand | 40.74-51.48 l/sq m/hr |
| High Rate Mixed Media | 81.48-122.22 l/sq m/hr |

Suspended solids are commonly removed from wastewater streams by filtering through a deep 0.3-0.9 m (1-3 feet) granular filter bed. The porous media bed can be designed to remove practically all suspended particles. Even colloidal suspensions (roughly 1 to 100 microns) are adsorbed on the surface of the media grains as they pass in close proximity in the narrow bed passages.

Data gathered from short-term sampling visits show that filter plants in all subcategories readily produce effluents with less than 10 mg/l TSS (See Appendix A). However, the analysis of long-term data for ten filtration systems has shown that higher values are more appropriate for performance standards. Based upon the statistical analysis for long-term TSS data the Agency has determined that a 30-day average of 15 mg/l TSS and a daily maximum of 40 mg/l TSS are attainable with filtration. Moreover, data for many steel industry subcategories demonstrate that these limits can be applied to most wastewaters treated by filtration.

## Advantages and Limitations

The principal advantages of filtration are low initial and operating costs, modest land requirements, lower effluent solids concentration, and the reduction or elimination of chemical additions which add to the discharge stream. However, the filter may require pretreatment if the suspended solids level is high (over 100 mg/l). In addition, operator training is necessary due to the controls and periodic backwashing involved.

## Operational Factors

a. Reliability: Filtration is a highly reliable method of wastewater treatment.

b. Maintainability: Deep bed filters may be operated with either manual or automatic backwashing. In either case, they must be periodically inspected for media retention, partial plugging and particulate leakage.

Demonstration Status

Filtration is one of the more common treatment methods used for steel industry wastewaters especially in the hot forming subcategory. This technology is used to treat a variety of wastewaters with similar results. Its ability to reduce the amount of solids, oils and metals in the wastewater is well demonstrated with both short and long-term data in the steel industry.

### Oil Removal

Oils and greases are removed from process wastewaters by several methods in the steel industry including oil skimming, filtration, and air flotation. Also, ultrafiltration is used at one cold rolling plant to remove oils. Oils may also be incidentally removed through other treatment processes such as clarification. The source of these oils is usually lubricants and preservative coatings used in the various steelmaking and finishing operations.

As a general matter, the most effective first step in oil removal is to prevent the oil from mixing with the large volume wastewater flows by segregating the sumps in all cellars and by appropriate maintenance of the lubrication and greasing systems. If the segregation is accomplished, more efficient removals of the oils and greases from wastewaters can be accomplished. The oil removal equipment used in the steel industry is described below.

1. Skimming

Pollutants with a specific gravity less than water will often float unassisted to the surface of the wastewater. Skimming is used to remove these floating wastes. Skimming normally takes place in a tank designed to allow the floating debris to rise and remain on the surface, while the liquid flows to an outlet located below the floating layer. Skimming devices are therefore suited to the removal of nonemulsified oils from untreated wastewaters. Common skimming mechanisms include the rotating drum type, which picks up oil from the surface of the water as the drum rotates. A doctor blade scrapes oil from the drum and collects it in a trough for disposal or reuse. The water portion is allowed to flow under the rotating drum. An underflow baffle is usually installed after the drum; this has the advantage of retaining any floating oil which escapes the drum skimmer. The belt type skimmer is pulled vertically through the water, collecting oil which is then scraped off from the belt surface and collected in a storage tank. The industry also uses rope and belt skimmers of various design that function in the same fashion. Gravity separators, such as the API type, use overflow and underflow baffles to skim a layer of floating oil from the surface of the wastewater. An overflow-underflow baffle allows a small amount of wastewater (the oil portion) to flow over into a trough for disposition or reuse while most of the water flows underneath the baffle. This is followed by an overflow baffle, which is set at a height relative to the first baffle such that only the oil bearing portion will flow over the first baffle during normal plant operation. A diffusion device, such as a vertical slot baffle, aids in creating a uniform flow through the system and increasing oil removal efficiency.

### Application and Performance

Skimming may be used on any wastewater containing pollutants which float to the surface. It is commonly used to remove free oil, grease, and soaps. Skimming is always used with air flotation and often with clarification to improve removal of both settling and floating materials.

The removal efficiency of a skimmer is a function of the density of the material to be floated and the retention time of the wastewater in the tank. The retention time required to allow phase separation and subsequent skimming varies from 1 to 15 minutes, depending upon wastewater characteristics.

API or other gravity-type separators tend to be more suitable for use where the amount of surface oil flowing through the system is fairly high and consistent. Drum and belt type skimmers are suitable where oil can be allowed to collect in a treatment device for periodic or continuous removal. Data for various oil skimming operations are presented in Appendix A.

### Advantages and Limitations

Skimming as pretreatment is effective in removing naturally floating waste material. It also improves the performance of subsequent downstream treatments.

Many pollutants, particularly dispersed or emulsified oil, will not float "naturally" but require additional treatment. Therefore, skimming alone may not remove all the pollutants capable of being removed by air flotation or other more sophisticated technologies.

### Operational Factors

a. Reliability: Because of its simplicity, skimming is a very reliable technique. During cold weather, heating is usually required for the belt-type skimmers.

b. Maintainability: The skimming mechanism requires periodic lubrication, adjustment, and replacement of worn parts.

### Demonstration Status

Skimming is a common method used to remove floating oil in many industrial categories, including the steel industry. Skimming is used extensively to treat wastewaters from hot forming, continuous casting, and cold forming operations.

## 2. Filtration

As explained above, filtration is also used to remove oils and greases from steel industry wastewaters. The mechanism for removing oils is very similar to the solids removal mechanism. The oils and greases, either floating or emulsified types, are directed into the filter where they are adsorbed on the filter media. Significant oil reductions can be achieved with filtration, and problems with the oils are not experienced unless high concentrations of oils are allowed to reach the filter bed. When this occurs the bed can be "blinded" and must be backwashed immediately. If too much oil is in the filter wastewater, frequent backwashing is necessary which makes the use of the technology unworkable. Therefore, proper pretreatment is essential for the proper operations of filtration equipment.

### Application and Performance

The discussion presented above for filtration systems applies here as well. The filter will reduce oil from moderate levels down to extremely low levels. Long-term data for eight filtration systems demonstrate that an oil and grease performance standard as low as 3.5 mg/l can be readily attained on a 30-day average basis and 10 mg/l oil and grease can be readily attained on a daily maximum basis. However, because of problems with obtaining consistent analytical results in the range of 5 mg/l, the Agency has decided to establish only a maximum effluent limitation and standard based upon a daily maximum concentration of 10 mg/l for hot forming operations and other operations with similar wastewaters.

### Operational Factors and Demonstrated Status

See prior discussion on filtration.

## 3. Flotation

Flotation is a process which causes particles such as metal hydroxides or oils to float to the surface of a tank where they are concentrated and removed. Gas bubbles are released in the wastewater and attach to the solid particles, which increase their buoyancy and causes them to float. In principle, this process is the opposite of sedimentation.

Flotation is used primarily in the treatment of wastewaters that carry finely divided suspended solids or oil. Solids having a specific gravity only slightly greater than 1.0, which require abnormally long sedimentation times, may be removed by flotation.

This process may be performed in several ways: foam, dispersed air, dissolved air, gravity, and vacuum flotation are the most commonly used techniques. Chemical additives are often used to enhance the performance of the flotation process. For example, acid and chemical aids are often used to break oil emulsions in cold rolling wastewaters. The emulsions are part of rolling solutions used in the process. Emulsion breaking is necessary for proper treatment of most cold rolling wastewaters by flotation.

The principal difference between types of flotation techniques is the method of generating the minute gas bubbles (usually air) needed to float the oil. Chemicals may be used to improve the efficiency of any of the basic methods. The different flotation techniques and the method of bubble generation for each process are described below.

Froth Flotation: Froth flotation is based upon the differences in the physiochemical properties of various particles. Wetability and surface properties affect particle affinity to gas bubbles. In froth flotation, air is blown through the solution containing flotation reagents. The particles with water repellent surfaces stick to air bubbles and are brought to the surface. A mineralized froth layer, with mineral particles attached to air bubbles, is formed. Particles of other minerals which are readily wetted by water do not stick to air bubbles and remain in suspension.

Dispersed Air Flotation: In dispersed air flotation, gas bubbles are generated by introducing the air by mechanical agitation with impellers or by forcing air through porous media. Dispersed air flotation is used mainly in the metallurgical industry.

Dissolved Air Flotation: In dissolved air flotation, bubbles are produced as a result of the release of air from a supersaturated solution under relatively high pressure.

There are two types of contact between the gas bubbles and particles. The first involves the entrapment of rising gas bubbles in the flocculated particles as they increase in size. The bond between the bubble and particle is one of physical capture only. This is the predominant type of contact. The second type of contact is one of adhesion. Adhesion results from the intermolecular attraction exerted at the interface between the solid particle and gaseous bubble.

Vacuum Flotation: This process consists of saturating the wastewater with air, either directly in an aeration tank or by permitting air to enter the suction of a pump. A partial vacuum causes the dissolved air to come out of solution as minute bubbles. The bubbles attach to solid particles and form a scum blanket on the surface, which is normally removed by a skimming mechanism. Grit and other heavy solids which settle to the bottom are generally raked to a central sludge pump for removal. A typical vacuum flotation unit consists of a covered cylindrical tank in which a partial vacuum is maintained. The tank is equipped with scum and sludge removal mechanisms. The floating material is continuously swept to the tank periphery, automatically discharged into a scum trough, and removed from the unit by a pump also under partial vacuum.

## Application and Performance

Flotation is commonly used to treat cokemaking and cold forming wastewaters. Gas (hydrogen) flotation is used at several cokemaking operations to control oil levels. Dissolved air flotation is used extensively to treat cold rolling wastewaters. The flotation process is used after emulsion breaking and prior to final settling. Data for three steel industry flotation units are presented below.

Performance of Flotation Units

| Plant | Oil & Grease (mg/l) In | Oil & Grease (mg/l) Out |
|---|---|---|
| 0684F (cokemaking) | 93 | 45 |
| 0684F (cold rolling) | NA | 7.3 |
| 0060B | 41,140 | 98 |

## Advantages and Limitations

The advantages of the flotation process include the high levels of solids and oil separation which are achieved in many applications; relatively low energy requirements; and, the capability to adjust air flow to meet the varying requirements of treating different types of wastewaters. The limitations of flotation are that it often requires addition of chemicals to enhance process performance; it requires properly trained and attentive operators; and it generates large quantities of solid wastes.

Operational Factors

a. Reliability: The reliability of a flotation system is normally high and is governed by proper operation of the sludge collector mechanism and by the motors and pumps used for aeration.

b. Maintainability: Maintenance of the scraper blades used to remove the floated material is critical for proper operations. Routine maintenance is required on the pumps and motors. The sludge collector mechanism is subject to possible corrosion or breakage and may require periodic replacement.

Demonstration Status

Flotation is extensively demonstrated in the steel industry, particularly for the treatment of cokemaking and cold rolling wastewaters.

### 4. Ultrafiltration

Ultrafiltration (UF) includes the use of pressure and semipermeable polymeric membranes to separate emulsified or colloidal materials suspended in a liquid phase. The membrane of an ultrafiltration unit forms a molecular screen which retains molecular particles based upon their differences in size, shape, and chemical structure. The membrane permits passage of solvents and lower molecular weight molecules. At present, ultrafiltration systems are used to remove materials with molecular weights in the range of 1,000 to 100,000 and particles of comparable or larger sizes.

In the ultrafiltration process, the wastewater is pumped through a tubular membrane unit. Water and some low molecular weight materials pass through the membrane under the applied pressure of 10 to 100 psig. Emulsified oil droplets and suspended particles are retained, concentrated, and removed continuously. In contrast to ordinary filtration, retained materials are washed off the membrane filter rather than held by it.

Application and Performance

Ultrafiltration has potential application in cold rolling operations for separating oils and residual solids from the process wastes. Because of the ability to remove emulsified oils with little or no pretreatment, ultrafiltration is well suited for many of the wastewaters generated at cold rolling mills. Also, some organic compounds of suitable molecular weight may be bound in the oily wastes which are removed. Hence, ultrafiltration could prove to be an effective means to achieve toxic organic pollutant removal for the cold rolling subdivision.

The following test data depict ultrafiltration performance for the treatment of cold rolling wastewaters at one plant:

Ultrafiltration Performance

| | Feed (mg/l) | Permeate (mg/l) |
|---|---|---|
| Oil (freon extractable) | 82,210 | 140 |
| TSS | 2,220 | 199 |
| Chromium | 6.5 | 1.2 |
| Copper | 7.5 | 0.07 |
| 2-chlorophenol | 35.5 | ND |
| 2-nitrophenol | 70.0 | 0.02 |

When the concentration of pollutants in the wastewater is high (as above) the ultrafiltration unit alone may not adequately treat the wastewater. Additional treatment may be required prior to discharge.

### Advantages and Limitations

Ultrafiltration is an attractive alternative to chemical treatment in certain applications because of lower installation and operating costs, high oil and suspended solids removal, and little required pretreatment. It places a positive barrier between pollutants and effluent which reduces the possibility of extensive pollutant discharge due to operator error or upset in settling and skimming systems. Another possible application is recovering alkaline values from alkaline cleaning solutions.

A limitation on the use of ultrafiltration for treating wastewaters is its narrow temperature range (18 to 30 degrees C) for satisfactory operation. Membrane life is decreased with higher temperatures, but flux increases at elevated temperatures. Therefore, the surface area requirements are a function of temperature and become a tradeoff between initial costs and replacement costs for the membrane. Ultrafiltration is not suitable for certain solutions. Strong oxidizing agents, solvents, and other organic compounds can dissolve the membrane. Fouling is sometimes a problem, although the high velocity of the wastewater normally creates enough turbulence to keep fouling at a minimum. Large solids particles are also sometimes capable of puncturing the membrane and must be removed by gravity settling or filtration prior to ultrafiltration.

## Operational Factors

a. Reliability: The reliability of ultrafiltration systems is dependent upon the proper filtration, settling or other treatment of incoming wastewaters to prevent damage to the membrane. Pilot studies should be completed for each application to determine necessary pretreatment steps and the specific membrane to be used.

b. Maintainability: A limited amount of regular maintenance is required for the pumping system. In addition, membranes must be periodically changed. The maintenance associated with membrane plugging can be reduced by selecting a membrane with optimum physical characteristics and providing sufficient velocity of the wastewater. It is necessary to pass a detergent solution through the system at regular intervals to remove an oil and grease film which accumulates on the membrane. With proper maintenance membrane life can be greater than twelve months.

## Demonstration Status

The ultrafiltration process is well developed and commercially available for treatment of wastewater or recovery of certain high molecular weight liquid and solid contaminants. Over 100 units are presently in operation in the United States. Ultrafiltration is demonstrated in the steel industry in the cold forming subcategory.

## Metals Removal

Steel industry wastewaters contain significant levels of toxic metal pollutants including chromium, copper, lead, nickel, zinc and others. These pollutants are generally removed by chemical precipitation and sedimentation or filtration. Most can be effectively removed by precipitating metal hydroxides or carbonates through reactions with lime, sodium hydroxide, or sodium carbonate. Sodium sulfide, ferrous sulfide, or sodium bisulfite can also be used to precipitate metals as sulfide compounds with low solubilities.

Hexavalent chromium is generally present in galvanizing and oxidizing salt bath descaling wastewaters. Reduction of this pollutant to the trivalent form is required if precipitation as the hydroxide is to be achieved. Where sulfide precipitation is used, hexavalent chromium can be reduced directly by the sulfide. Chromium reduction using sulfur dioxide or sodium bisulfite or by electrochemical techniques may be necessary, however, when hydroxides are precipitated.

Details on various metal removal technologies are presented below with typical treatability levels where data are available.

1. Chemical Precipitation

Dissolved toxic metal ions and certain anions may be chemically precipitated and removed by physical means such as sedimentation, filtration, or centrifugation. Several reagents are commonly used to effect this precipitation.

a. Alkaline compounds such as lime or sodium hydroxide may be used to precipitate many toxic metal ions as metal hydroxides. Lime also may precipitate phosphates as insoluble calcium phosphate and fluorides as calcium fluoride.

b. Both soluble sulfides such as hydrogen sulfide or sodium sulfide and insoluble sulfides such as ferrous sulfide may be used to precipitate many heavy metal ions as insoluble metal sulfides.

c. Carbonate precipitates may be used to remove metals either by direct precipitation using a carbonate reagent such as calcium carbonate or by converting hydroxides into carbonates using carbon dioxide.

These treatment chemicals may be added to a flash mixer or rapid mix tank, a presettling tank, or directly to a clarifier or other settling device. Coagulating agents may be added to facilitate settling. After the solids have been removed, a final pH adjustment may be required to reduce the high pH created by the alkaline treatment chemicals.

Chemical precipitation as a mechanism for removing metals from wastewater is a complex process made up of at least two steps: precipitation of the unwanted metals and removal of the precipitate. A small amount of metal will remain dissolved in the wastewater after complete precipitation. The amount of residual dissolved metal depends on the treatment chemicals used, the solubility of the metal and co-precipitation effects. The effectiveness of this method of removing any specific metal depends on the fraction of the specific metal in the raw waste (and hence in the precipitate) and the effectiveness of suspended solids removal.

## Application and Performance

Chemical precipitation is used extensively in the steel industry for precipitation of dissolved metals including aluminum, antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, tin, and zinc. The process is also applicable to any substance that can be transformed into an insoluble form such as fluorides, phosphates, soaps, sulfides, and others. Chemical precipitation is simple and effective.

The performance of chemical precipitation depends on several variables; the most important are:

a. Maintenance of an alkaline pH throughout the precipitation reaction and subsequent settling.

b. Addition of a sufficient excess of treatment ions to drive the precipitation reaction to completion.

c. Addition of an adequate supply of sacrifical ions (such as iron or aluminum) to ensure precipitation and removal of specific target ions.

d. Effective removal of precipitated solids (see appropriate technologies discussed under "Solids Removal").

A discussion of the performance of some of the chemical precipitation technologies used in the steel industry is presented below.

Lime Precipitation - Sedimentation Performance

Lime is sometimes used in conjunction with sedimentation technology to precipitate metals. Numerous examples of this technology are demonstrated in the steel industry, mostly for treatment of steel finishing wastewaters. Data for one plant and the median effluent concentration of long term averages for several plants using this technology are shown below. Plant 0584E has a lime precipitation/sedimentation treatment system which treats wastewaters from several finishing operations, including electroplating which is not covered as part of the steel industry category. The median data for the other plants were used to establish the effluent limitation for carbon steel finishing operations and are review in Appendix A of this volume.

## Lime Precipitation - Sedimentation Performance

| Pollutant | Concentration of Pollutants (mg/l)<br>Plant 0584E<br>In | <br>Plant 0584E<br>Out | Median Performance*<br>Out |
|---|---|---|---|
| Dissolved Iron | 0.25 | 0.01 | <0.02 |
| Chromium | 4.4 | 0.054 | 0.03 |
| Copper | - | - | 0.04 |
| Lead | - | - | 0.10 |
| Nickel | - | - | 0.15 |
| Tin | 4.4 | 0.0 | - |
| Zinc | 0.11 | 0.02 | 0.06 |
| TSS | 322 | 4.5 | 25 |
| pH | 2.9-6.8 | 7.0-7.4 | 6.0-9.0 |

*See Appendix A

## Lime Precipitation - Filtration Performance

A metals removal technology that is used in the steel industry similar to the lime/sedimentation system includes lime precipitation and filtration. These systems accomplish better solids and oil removal and also achieves slightly better control of the effluent concentration of the metallic elements. Data for two plants that employ lime precipitation/filtration technology are shown below. Pickling and galvanizing wastewaters are treated at plant 0612, while pickling, galvanizing and alkaline cleaning wastewaters are treated at plant 0112I. The median effluent concentrations of long term average for several plants which were used to establish the effluent limitations for filtration systems are also presented below. These effluent data are more thoroughly, reviewed in Appendix A of this volume. Pilot plant data for steelmaking wastewaters are also presented in Appendix A.

## Lime Precipitation - Filtration Performance

| | Concentration of Pollutants (mg/l) | | | | Median |
|---|---|---|---|---|---|
| Pollutant | Plant 0612 | | Plant 0112I | | Performance* |
| | In | Out | In | Out | Out |
| Chromium | 1.60 | 0.04 | 0.12 | 0.03 | 0.03 |
| Copper | 0.60 | 0.08 | 0.17 | 0.02 | 0.03 |
| Lead | 2.400 | 0.18 | 0.19 | <0.10 | 0.06 |
| Nickel | 0.60 | 0.02 | 0.08 | 0.03 | 0.04 |
| Zinc | 285.00 | 0.12 | 18.00 | 0.13 | 0.10 |
| TSS | 350.00 | 11.00 | 199.00 | 1.00 | 9.8 |
| pH | 2.9-3.9 | 8.3-8.5 | 5.2-5.6 | 7.3-7.7 | 6.0<br>9.0 |

*See Appendix A

## Sulfide Precipitation

Most metal sulfides are less soluble than hydroxides and the precipitates are frequently more dependably removed from water. Solubilities for selected metal hydroxides and sulfide precipitates are shown below:

Theoretical Solubilities of Hydroxides and Sulfides of Heavy Metals in Pure Water

| | Solubility of Metal, mg/l | |
|---|---|---|
| Metal | As hydroxide | As sulfide |
| Cadmium(Cd$^{+2}$) | $2.3 \times 10^{-5}$ | $6.7 \times 10^{-10}$ |
| Chromium (Cr$^{+3}$) | $8.4 \times 10^{-5}$ | No precipitate |
| Copper (Cu$^{+2}$) | $2.2 \times 10^{-2}$ | $5.8 \times 10^{-18}$ |
| Iron (Fe$^{+2}$) | $8.9 \times 10^{-1}$ | $3.4 \times 10^{-5}$ |
| Lead (Pb$^{+2}$) | $2.1 \times 10^{-0}$ | $3.8 \times 10^{-9}$ |
| Nickel (Ni$^{+2}$) | $6.9 \times 10^{-3}$ | $6.9 \times 10^{-8}$ |
| Silver (Ag$^{+2}$) | $13.0 \times 10^{-0}$ | $7.4 \times 10^{-12}$ |
| Tin (Sn$^{+2}$) | $1.1 \times 10^{-4}$ | $2.3 \times 10^{-7}$ |

Sulfide treatment has not been used in the steel industry on a full-scale basis. However, it has been used in other manufacturing process (e.g. electroplating) to remove metals from wastewaters with similar characteristics and pollutants to those of the steel industry.

In assessing whether this technology is transferable for use in steel industry, the Agency consulted numerous references; contacted sulfide precipitation equipment manufacturers, and gathered data from operating sulfide precipitation systems. The wastewaters treated by these sulfide precipitation systems were contaminated with many of the same toxic metals found in steel industry wastewaters and at similar concentrations. Accordingly, the Agency concluded that a transfer of the effectiveness of this technology is possible. However, as noted above there are no full scale systems currently in use in the steel industry.

Data for several sulfide/filtration systems are shown below.

Sulfide Precipitation/Filtration Performance

Concentration of Pollutants (mg/l)

| Pollutant | Data Set #1 |  | Data Set #2 |  |
|---|---|---|---|---|
|  | In | Out | In | Out |
| Chromium | 2.0 | <0.1 | 2.4 | <0.1 |
| Iron | 85.0 | 0.04 | 108 | 0.60 |
| Nickel | 0.6 | 0.10 | 0.68 | <0.1 |
| Zinc | 27.0 | <0.1 | 33.9 | <0.1 |
| TSS | 320 | 4.0 | - | - |
| pH | 2.9 | 8.2 | 7.7 | 7.4 |

Another benefit of the sulfide precipitation technology is the ability to precipitate hexavalent chromium ($Cr^{+6}$) without prior reduction to the trivalent state as is required in the hydroxide process. When ferrous sulfide is used as the precipitant, iron and sulfide act as reducing agents for the hexavalent chromium according to the reaction:

$$CrO_4^{=} + FeS + 4H_2O \rightarrow Cr(OH)_3 + Fe(OH)_3 + S + 2OH^-$$

In this reaction, the sludge produced consists mainly of ferric hydroxides, chromic hydroxides and various metallic sulfides. Some excess hydroxyl ions are generated in this process, possibly requiring a downward pre-adjustment of pH.

## Advantages and Limitations

Chemical precipitation is an effective technique for removing many pollutants from industrial wastewaters. It operates at ambient conditions and is well suited to automatic control. The use of chemical precipitation may be limited due to interference of chelating agents, chemical interferences from mixing wastewaters and treatment chemicals, and potentially hazardous situations involved with the storage and handling of those chemicals. Lime is usually added as a slurry when used in hydroxide precipitation. The slurry must be well mixed and the addition lines periodically checked to prevent fouling. In addition, hydroxide precipitation usually makes recovery of the precipitated metals difficult, because of the heterogeneous nature of most hydroxide sludges. As shown above, lime precipitation of steel industry finishing wastewaters can produce effluent quality similar to that shown for sulfide precipitation.

The low solubility of most metal sulfides, allow for high metal removal efficiencies. Also, the sulfide process has the ability to remove chromates and dichromates without preliminary reduction of the chromium to the trivalent state. Sulfide precipitation can be used to precipitate metals complexed with most complexing agents. However, Sulfids precipitation can be used to care must be taken to maintain the pH of the solution at approximately 10 in order to prevent the generation of toxic sulfide gas during this process. For this reason ventilation of the treatment tanks may be a necessary precaution in most installations. The use of ferrous sulfide reduces or virtually eliminates the problem of hydrogen sulfide evolution. As with hydroxide precipitation, excess sulfide ion must be present to drive the precipitation reaction to completion. Since the sulfide ion itself is toxic, sulfide addition must be carefully controlled to maximize heavy metals precipitation with a minimum of excess sulfide to avoid the necessity of post treatment. Where excess sulfide is present, aeration of the effluent stream can aid in oxidizing residual sulfide to the less harmful sodium sulfate ($Na_2SO_4$). The cost of sulfide precipitants is high in comparison with hydroxide precipitants, and disposal of metallic sulfide sludges may pose problems. An essential element in effective sulfide precipitation is the removal of precipitated solids from the wastewater and proper disposal in an appropriate site. Sulfide precipitation will also generate a higher volume of sludge than hydroxide precipitation, resulting in higher disposal and dewatering costs. This is especially true when ferrous sulfide is used as the precipitant.

Sulfide precipitation may be used as a final tratement step after hydroxide precipitation-sedimentation. This treatment configuration may provide the better treatment effectiveness of sulfide precipitation while minimizing the variability caused by changes in raw waste and reducing the amount of sulfide precipitant required.

### Operational Factors

a. Reliability: The reliability of alkaline chemical precipitation is high, although proper monitoring and control are necessary. Sulfide precipitation systems provide similar reliability.

b. Maintainability: The major maintenance needs involve periodic upkeep of monitoring equipment, automatic feeding equipment, mixing equipment, and other hardware. Removal of accumulated sludge is necessary for the efficient operation of precipitation-sedimentation systems.

Demonstration Status

Chemical precipitation of metal hydroxides is a classic wastewater treatment technology used throughout the steel industry. Chemical precipitation of metals in the carbonate form alone has been found to be feasible and, is used in commercial application to permit metals recovery and water reuse. Full scale commercial sulfide precipitation units are in operation at numerous installations, however, none are presently installed in the steel industry.

2. Filtration (for Metal Removal)

As discussed previously, filtration is a proven technology for the control of suspended solids and oil and grease. The filtration mechanism which reduces the concentrations of the suspended solids and oils also treats the metallic elements present in particulate form. To determine the treatability levels for metals using filtration the Agency compiled all available data for such systems. Data for seventeen filtration systems were averaged to develop the treated effluent concentrations. The average treated effluent concentrations and the proposed monthly average concentration for five toxic metals are shown below:

Metal Removal with Filtration Systems

| Pollutant | Monthly Average Concentration (mg/l) | Daily Maximum Concentration (mg/l) |
|---|---|---|
| Chromium | 0.04 | 0.12 |
| Copper | 0.04 | 0.12 |
| Lead | 0.08 | 0.24 |
| Nickel | 0.05 | 0.16 |
| Zinc | 0.08 | 0.24 |

For purposes of developing effluent limitations, the Agency is using 30 day average concentrations of 0.10 mg/l and daily maximum concentrations of 0.30 mg/l for each toxic metal except zinc. For zinc, the Agency is using a 30 day average concentration of 0.15 mg/l and daily maximum concentration of 0.45 mg/l, since the performance standard for zinc was greater than 0.10 mg/l. The Agency rounded the zinc performance standard to 0.15 mg/l. Reference is made to Appendix A for development of toxic metals effluent concentrations.

### Advantages and Limitations

See prior discussion on filtration systems.

### Operational Factors and Demonstration Status

See prior discussion on filtration systems.

## Organic Removal

Thirty-three organic toxic pollutants were detected in steel industry wastewaters above treatability levels. Because some of these pollutants are present in significant levels, the Agency considered two demonstrated treatment alternatives for these pollutants in several subcategories: carbon adsorption and biological treatment (activated sludge). These technologies are discussed separately below.

### 1. Carbon Adsorption

The use of activated carbon for removal of dissolved organics from water and wastewater has been demonstrated and is one of the most efficient organic removal processes available. Activated carbon has also been shown to be an effective adsorbent for many toxic metals, including mercury. This process is reversible, thus allowing activated carbon to be regenerated and reused by the application of heat and steam or solvent. Regeneration of carbon which has adsorbed significant metals, however, may be difficult.

The term activated carbon applies to any amorphous form of carbon that has been specially treated to give high adsorption capacities. Typical raw materials include coal, wood, coconut shells, petroleum base residues and char from sewage sludge pyrolysis. A carefully controlled process of dehydration, carbonization, and oxidation yields a product which is called activated carbon. This material has a high capacity for adsorption due primarily to the large surface area available for adsorption (500- 1500 square meters/gram) which result from a large number of internal pores. Pore sizes generally range in radius from 10-100 angstroms.

Activated carbon removes contaminants from water by the process of adsorption (the attraction and accumulation of one substance on the surface of another). Activated carbon preferentially adsorbs organic compounds and, because of this selectivity, is particularly effective in removing toxic organic pollutants from wastewaters.

Carbon adsorption requires pretreatment (usually filtration) to remove excess suspended solids, oils, and greases. Suspended solids in the influent should be less than 50 mg/l to minimize backwash requirements. A downflow carbon bed can handle much higher levels (up to 2000 mg/l), but frequent backwashing is required. Backwashing more than two or three times a day is not desirable. Oil and grease should be less than about 15 mg/l. A high level of dissolved inorganic material in the influent may cause problems with thermal carbon reactivation (i.e., scaling and loss of activity) unless appropriate preventive steps are taken. Such steps might include pH control, softening, or the use of an acid wash on the carbon prior to reactivation.

Activated carbon is available in both powdered and granular form. Powdered carbon is less expensive per unit weight and may have slightly higher adsorption capacity but it is more difficult to handle and to regenerate.

## Application and Performance

Activated carbon has been used in a variety of applications involving the removal of objectional organics from wastewater streams. One of the more frequent uses is to reduce the concentration of oxygen demanding substances in POTW effluents. It is also used to remove specific organic contaminants in the wastewaters of various manufacturing operations such as petroleum refining. There are two full scale activated carbon systems in use in the steel industry for treating cokemaking wastewaters.

Tests performed on single compound systems indicate that processing with activated carbon can achieve residual levels on the order of 1 microgram per liter for many of the toxic organic pollutants. Compounds which respond well to adsorption include carbon tetrachloride, chlorinated benzenes, chlorinated ethanes, chlorinated phenols, haloethers, phenols, nitrophenols, DDT and metabolites, pesticides, polynuclear aromatics and PCB's. Plant scale systems treating a mixture of many organic compounds must be carefully designed to optimize certain critical factors.

Factors which affect overall adsorption of mixed solutes include relative molecular size, the relative adsorptive affinities, and the relative concentration of the solutes. Data indicate that column treatment with granular carbon provides for better removal of organics than clarifier contact treatment with powdered carbon.

Data from two activated carbon column systems used in the steel industry and EPA treatability data for carbon adsorption systems were combined to develop performance standards for carbon column systems. The average concentration values attainable with carbon adsorption systems are shown in Table VI-1 for those toxic organics found above treatability levels in steel industry wastewaters.

## Advantages and Limitations

The major benefits of carbon treatment include applicability to a wide variety of organics, and a high removal efficiency. The system is not sensitive to fairly wide variations in concentration and flow rates. The system is compact, and recovery of adsorbed materials is sometimes practical. However, the destruction of adsorbed compounds often occurs during thermal regeneration. If carbon cannot be thermally desorbed, it must be disposed of along with any adsorbed pollutants. When thermal regeneration is used, capital and operating costs are generally economical when carbon usage exceeds about 1,000 lb/day. Carbon does not efficiently remove low molecular weight or highly soluble organic compounds.

## Operational Factors

a. Reliability: This system is very reliable with proper pretreatment and proper operation and maintenance.

b. Maintainability: This system requires periodic regeneration or replacement of spent carbon and is dependent upon raw waste load and process efficiency.

## Demonstration Status

Carbon adsorption systems have been demonstrated to be practical and economical for the reduction of COD, BOD and related pollutants in secondary municipal and industrial wastewaters; for the removal of toxic or refractory organics from isolated industrial wastewaters; for the removal and recovery of certain organics from wastewaters; and for the removal, at times with recovery, of selected inorganic chemicals from aqueous wastes. Carbon adsorption is considered a viable and economic process for organic waste streams containing up to 1 to 5 percent of refractory or toxic organics. It also has been used to remove toxic inorganic pollutants such as metals.

Granular carbon adsorption is demonstrated on a full scale basis at tow plants in the cokemaking subcategory and one blast furnace and sintering operation. Additionally, a powered carbon addition study has been piloted for biological treatment of cokemaking wasterwaters.

## 2. Biological Oxidation

Biological treatment is another method of reducing the concentration of ammonia-n, cyanide, phenols (4AAP) and toxic organic pollutants from process wastewaters. Biological systems, both single and two-stage, have been used effectively to treat sanitary wastewaters. The activated sludge system is well demonstrated in the steel industry, although other systems including rotating biological disks have also been studied.

In the activated sludge process, wastewater is stablized biologically in a reactor under aerobic conditions. The aerobic environment is achieved by the use of diffused or mechanical aeration. After the wastewater is treated in the reactor, the resulting biological mass is separated from the liquid in a settling tank. A portion of the settled biological solids is recycled and the remaining mass is wasted. The level at which the biological mass should be maintained in the system depends upon the desired treatment efficiency, the particular pollutants that are to be removed and other considerations related to growth kinetics.

The activated sludge system generally is sensitive to fluctuations in hydraulic and pollutant loadings, temperature and certain pollutants. Temperature not only influences the metabolic activities of the microbiological population, but also has an effect on such factors as gas transfer rates and the settling characteristics of the biological solids. Some pollutants are extremely toxic to the microorganisms in the system, such as ammonia at high concentrations and tocix metals. Therefore, sufficient equalization and pretreatment must be installed ahead of the biological reactor so that high levels of toxic pollutants do not enter the system and "kill" the microorganism population. If the biological conditions in an activated sludge plant are upset, it can be a matter of days or weeks before biological activity returns to normal.

## Application and Performance

Although a great deal of information is available on the performance of activated sludge units in controlling phenolic compounds, cyanides, ammonia, and BOD, limited long-term data are available regarding toxic pollutants other than phenolic compounds, cyanides, and ammonia. Only lately has there been an emphasis upon the performance of the activated sludge units on the toxic organic pollutants.

Originally, advanced levels of treatment using a biological system were expected to involve multiple stages for accomplishing selective degradation of pollutants in series, e.g., phenolic compounds and cyanide removal, nitrification, and dentrification. The Agency sampled the wastewaters of two well operated biological plants in the cokemaking subcategory. Both of these plants achieved good removals of toxic pollutants with organic removal averaging better than

90% and completely eliminating phenolic compounds, naphthalene, and xylene. The monitoring data for one of these plants were used to develop performance standards for ammonia-N, cyanide, phenols (4AAP), and toxic organic pollutants for biological oxidation systems. These standards are shown in Table VI-1 for those toxic pollutants found in the steel industry wastewaters above treatability levels.

Advantages and Limitations

The activated sludge system achieves significant reductions of most toxic organic pollutants at significantly less capital and operating costs than for carbon adsorption. Also, consistent effluent quality can be maintained if sufficient pretreatment is practiced and shock loadings of specific pollutants are eliminated. The temperature, pH and oxygen levels in the system must be maintained within certain ranges or fluctuating removal efficiencies of some pollutants will occur.

Operational Factors

a. Reliability: This system is very reliable with proper pretreatment and proper operation and maintenance.

b. Maintainability: As long as adequate pretreatment is practiced, high effluent quality can be maintained. If the system is upset, the operation can be brought under control by seeding with biological floc or POTW sludges.

Demonstration Status

Activated sludge systems are well demonstrated in the steel industry. Biological oxidation systems are installed at eighteen cokemaking operations.

Advanced Technologies

The Agency considered other advanced treatment technologies as possible alternative treatment systems. Ion exchange and reverse osmosis were considered because of their treatment effectiveness and because, in certain applications, they allow the recovery of certain process material.

1. Ion Exchange

Ion exchange is a process in which ions, held by electrostatic forces to charged functional groups on the surface of the ion exchange resin, are exchanged for ions of similar charge from the solution in which the resin is immersed. This is classified as an absorption process because the exchange occurs on the surface of the resin, and the exchanging ion must undergo a phase transfer from solution phase to solid phase. Thus, ionic contaminants in a wastewater can be exchanged for the harmless ions of the resin.

Low exchange systems used to treat wastewaters are always preceeded by filters to remove suspended matter which could foul the low exchange resin. The wastewater then passes through a cation exchanger which contains the ion exchange resin. The exchanger retains metallic impurities such as copper, iron, and trivalent chromium. The wastewater is then passed through the anion exchanger which has a different resin. Hexavalent chromium, for example, is retained in this stage. If the wastewater is not effectively treated in one pass through it may be passed through another series of exchangers. Many ion exchange systems are equipped with more than one set of exchangers for this reason.

The other major portion of the ion exchange process is the regeneration of the resin, which holds impurities removed from the wastewater. Metal ions such as nickel are removed by an acid cation exchange resin, which is regenerated with hydrochloric or sulfuric acid, replacing the metal ion with one or more hydrogen ions. Anions such as dichromate are removed by a basic anion exchange resin, which is regenerated with sodium hydroxide, replacing the anion with one or more hydroxyl ions. The three principal methods used by industry for regenerating the spent resins are:

a. Replacement Service: A regeneration service replaces the spent resin with regenerated resin, and regenerates the spent resin at its own facility. The service then treats and disposes of the spent regenerant.

b. In-Place Regeneration: Some establishments may find it less expensive to conduct on-site regeneration. The spent resin column is shut down for perhaps an hour, and the spent resin is regenerated. This results in one or more waste streams which must be treated in an appropriate manner. Regeneration is performed as the resins require it, usually every few months.

c. Cyclic Regeneration: In this process, the regeneration of the spent resins takes place within the ion exchange unit itself in alternating cycles with the ion removal process. A regeneration permits operation with a very small quantity of resin and with fairly concentrated solutions, resulting in a very compact system. Again, this process varies according to application, but the regeneration cycle generally begins with caustic being pumped through the anion exchanger, which carries out hexavalent chromium, for example, as sodium dichromate. The sodium dichromate stream then passes through a cation exchanger, converting the sodium dichromate to chromic acid. After being concentrated by evaporation or other means, the chromic acid can be returned to the process line. Meanwhile, the cation exchanger is regenerated with sulfuric acid, resulting in a waste acid stream containing the metallic impurities removed earlier. Flushing the exchangers with water completes the cycle. Thus, the wastewater is purified and, in this example, chromic acid is recovered. The ion exchangers, with newly regenerated resin, then enter the ion removal cycle again.

## Application and Performance

The list of pollutants for which the ion exchange system has proven effective includes, among others, aluminum, arsenic, cadmium, chromium (hexavalent and trivalent), copper, cyanide, gold, iron, lead, manganese, nickel, selenium, silver, tin, and zinc. Thus, it can be applied at a wide variety of industrial concerns. Because of the heavy concentrations of metals in metal finishing wastewaters, ion exchange is used extensively in that industry. As an end-of-pipe treatment, ion exchange is certainly feasible, but its greatest value is in recovery applications. It is commonly used as an integrated treatment to recover rinse water and process chemicals. At some electroplating facilities ion exchange is used to concentrate and purify plating baths.

Ion exchange is highly efficient at recovering metal bearing solutions. Recovery of chromium, nickel, phosphate solutions, and sulfuric acid from anodizing is commercially viable. A chromic acid recovery efficiency of 99.5 percent has been demonstrated. Ion exchange systems are reported to be installed at three pickling operations, however, none of these systems were sampled during this study. Data for two plants in the coil coating category are shown below.

## Ion Exchange Performance

| Pollutant | Plant A | | Plant B | |
|---|---|---|---|---|
| All Values mg/l | Prior to Purification | After Purification | Prior to Purification | After Purification |
| Al | 5.6 | 0.20 | - | - |
| Cd | 5.7 | 0.00 | - | - |
| $Cr^{+3}$ | 3.1 | 0.01 | - | - |
| $Cr^{+6}$ | 7.1 | 0.01 | - | - |
| Cu | 4.5 | 0.09 | 43.0 | 0.10 |
| CN | 9.8 | 0.04 | 3.40 | 0.09 |
| Au | - | - | 2.30 | 0.10 |
| Fe | 7.4 | 0.01 | - | - |
| Pb | - | - | 1.70 | 0.01 |
| Mn | 4.4 | 0.00 | - | - |
| Ni | 6.2 | 0.00 | 1.60 | 0.01 |
| Ag | 1.5 | 0.00 | 9.10 | 0.01 |
| $SO_4$ | - | - | 210.00 | 2.00 |
| Sn | 1.7 | 0.00 | 1.10 | 0.10 |
| Zn | 14.8 | 0.40 | - | - |

## Advantages and Limitations

Ion exchange is a versatile technology applicable to a great many situations. This flexibility, along with its compact nature and performance, makes ion exchange an effective method of wastewater treatment. However, the resins in these systems can prove to be a limiting factor. The thermal limits of the anion resins, generally placed in the vicinity of 60°C, could prevent its use in certain situations. Similarly, nitric acid, chromic acid, and hydrogen peroxide can all damage the resins as will iron, manganese, and copper when present with sufficient concentrations of dissolved oxygen. Removal of a particular trace contaminant may be uneconomical because of the presence of other ionic species that are preferentially removed. The regeneration of the resins presents its own problems. The cost of the regenerative chemicals can be high. In addition, the wastewater streams originating from the regeneration process are extremely high in pollutant cncentrations, although low in volume. These must be further processed for proper disposal.

## Operational Factors

a. Reliability: With the exception of occasional clogging or fouling of the resins, ion exchange is a highly dependable technology.

b. Maintainability: Only the normal maintenance of pumps, valves, piping and other hardware used in the regeneration process is usually encountered.

Demonstration Status

All of the applications mentioned in this section are available for commercial use, and industry sources estimate the number of units currently in the field at well over 120. The research and development in ion exchange is focusing on improving the quality and efficiency of the resins, rather than new applications. Ion exchange is used in at least three different plants in the steel industry. Also, ion exchange is used in a variety of other metal finishing operations.

## 2. Reverse Osmosis

Reverse osmosis (RO) is an operation in which pressure is applied to a solution on the outside of a semi-permeable membrane causing a permeate to diffuse through the membrane leaving behind concentrated higher molecular weight compounds. The concentrate can be further treated or returned to the original operation for continued use, while the permeate water can be recycled for use as clean water.

There are three basic configurations used in commercially available RO modules: tubular, sprial-wound, and hollow fiber. All of these operate on the principle described above, the major difference being their mechanical and structural design characteristics.

The tubular membrane module has a porous tube with a cellulose acetate membrane-lining. A common tubular module consists of a length of 2.5 cm (1 inch) diameter tube wound on a supporting spool and encased in a plastic shroud. Feed water is driven into the tube under pressures varying from 40-55 atm (600-800 psi). The permeate passes through the walls of the tube and is collected in a manifold while the concentrate is drained off at the end of the tube. A less widely used tubular RO module has a straight tube contained in a housing, and is operated under the same conditions.

Spiral-wound membranes consist of a porous backing sandwiched between two cellulose acetate membrane sheets and bonded along three edges. The fourth edge of the composite sheet is attached to a large permeate collector tube. A spacer screen is then placed on top of the membrane sandwich and the entire stack is rolled around the centrally located tubular permeate collector. The rolled up package is inserted into a pipe able to withstand the high operating pressures employed in this process, up to 55 atm (800 psi). When the system is operating, the pressurized product water permeates the membrane and flows through the backing material to the central collector tube. The concentrate is drained off at the end of the container pipe and can be reprocessed or sent to further treatment facilities.

The hollow fiber membrane configuration is made up of a bundle of polyamide fibers of approximately 0.0075 cm (0.003 in.) OD and 0.0043 cm (0.0017 in.) ID. A commonly used hollow fiber module contains several hundred thousand of the fibers placed in a long tube, wrapped around a flow screen, and rolled into a spiral. The fibers are bent in a U-shape and their ends are supported by an epoxy bond. The hollow fiber unit is operated under 27 atm (400 psi), the feed water being dispersed from the center of the module through a porous distributor tube. The permeate flows through the membrane to the hollow interiors of the fibers and is collected at the ends of the fibers.

The hollow fiber and spiral-wound modules have a distinct advantage over the tubular system in that they contain a very large membrane surface area in a relatively small volume. However, these membranes types are much more susceptible to fouling than the tubular system, which has a larger flow channel. This characteristic also makes the tubular membrane easier to clean and regenerate than either the spiral-wound or hollow fiber modules.

## Application and Performance

At a number of metal processing plants, the overflow from the first rinse in a countercurrent setup is directed to a reverse osmosis unit, where it is separated into two streams. The concentrated stream contains dragged out chemicals and is returned to the bath to replace the loss of solution due to evaporation and dragout. The dilute stream (the permeate) is routed to the last rinse tank to provide water for the rinsing operation. The rinse flows from the last tank to the first tank and the cycle is complete.

The closed-loop system described above may be supplemented by the addition of a vacuum evaporator after the RO unit in order to further reduce the volume of reverse osmosis concentrate. The evaporated vapor can be condensed and returned to the last rinse tank or sent on for further treatment.

The largest application of reverse osmosis systems is for the recovery of nickel and other metal solutions. It has been shown that RO can generally be applied to most acid metal baths with a high degree of performance, providing that the membrane unit is not overtaxed. The limitations most critical are the allowable pH range and maximum operating pressure for each particular configuration.

Adequate prefiltration is also essential. Only three membrane types are readily available in commercial RO units. For the purpose of calculating performance predictions of this technology, a rejection rate of 98 percent was assumed for dissolved salts, with 95 percent permeate recovery.

## Advantages and Limitations

The major advantage of reverse osmosis for treating wastewaters is the ability to concentrate dilute solutions for recovery of salts and chemicals with low power requirements. No latent heat of vaporization or fusion is required for effecting separations; the main energy requirement is for a high pressure pump. RO requires relatively little floor space for compact, high capactiy units, and exhibits high recovery and rejection rates for a number of typical process solutions. A limitation of the reverse osmosis process is the limited temperature range for satisfactory operation. For cellulose acetate systems, the preferred limits are 18 to 30°C (65 to 85°F); higher temperatures will increase the rate of membrane hydrolysis and reduce system life, while lower temperatures will result in decreased fluxes with no damage to the membrane. Another limitation is the inability to handle certain solutions. Strong oxidizing agents, strong acidic or basic solutions, solvents, and other organic compounds can cause dissolution of the membrane. Poor rejection of some compounds such as borates and low molecular weight organics is another problem. Fouling of membranes by failures, and fouling of membranes by wastewaters with high levels of suspended solids can be a problem. A final limitation is the inability to treat or achieve high concentration with some solutions. Some concentrated solutions may have initial osmotic pressures which are so high that they either exceed available operating pressures or are uneconomical to treat.

## Operational Factors

a. Reliability: RO systems are reliable provided the proper precautions are taken to minimize the chances of fouling or degrading the membrane. Sufficient testing of the wastewater stream prior to application of an RO system will provide the information needed to insure a successful application.

b. Maintainability: Membrane life is estimated to fall between 6 months and 3 years, depending upon the use of the system. Down time for flushing or cleaning is on the order of two hours as often as once each week; a substantial portion of maintenance time must be spent on cleaning any prefilters installed ahead of the reverse osmosis unit.

### Demonstration Status

There are presently at least one hundred reverse osmosis wastewater applications in a variety of industries. In addition to these, thirty to forty units are used to provide pure process water for several industries. Despite the many types and configurations of membranes, only the spiral-wound cellulose acetate membrane has had widespread success in commercial applications. There are no known RO units presently in operation in the steel industry to treat wastewaters.

## Zero Discharge Technologies

Zero discharge of process wastewater is achieved in several subcategories of the steel industry. The most commmonly used method is to treat the wastewater sufficiently so it can be completely reused in the originating process or to control water application in semi-wet air pollution control systems so that no discharge results. This method is used principally in steelmaking.

Another potential means to achieve zero discharge is by the use of evaporation technology. Evaporation systems concentrate the wastewater constituents and produce a distillate quality water that can be recycled to the process. Although this technology is very costly and energy intensive, it may be the only method available to attain zero discharge in many steel industry subcategories.

### Evaporation

Evaporation is a concentration process. Water is evaporated from a solution, increasing the concentration of solute in the remaining solution. If the resulting water vapor is condensed back to liquid water, the evaporation-condensation process is called distillation. However evaporation is used in this report to describe both processes. Both atmospheric and vacuum evaporation are commonly used in industry today. Atmospheric evaporation could be accomplished simply by boiling the liquid. However, to aid evaporation, heated liquid is sprayed on an evaporation surface, and air is blown over the surface and subsequently released to the atmosphere. Thus, evaporation occurs by humidification of the air stream, similar to a drying process. Equipment for carrying out atmospheric evaporation is quite similar for most applications. The major element is generally a packed column with an accumulator bottom. Accumulated wastewater is pumped from the base of the column, through a heat exchanger, and back into the top of the column, where it is sprayed into the packing. At the same time, air drawn upward through the packing by a fan is heated as it contacts the hot liquid. The liquid partially vaporizes and humidifies the air stream. The fan then blows the hot, humid air to the outside atmosphere.

Another form of atmospheric evaporator also works on the air humidification principle, but the evaporated water is recovered for reuse by condensation. These air humidification techniques operate well below the boiling point of water and can use waste process heat to supply some of the energy required.

In vacuum evaporation, the evaporation pressure is lowered to cause the liquid to boil at reduced temperature. All of the water vapor is condensed and, to maintain the vacuum condition, noncondensible gases (air in particular) are removed by a vacuum pump. Vacuum evaporation may be either single or double effect. In double effect evaporation, two evaporators are used, and the water vapor from the first evaporator (which may be heated by steam) is used to supply heat to the second evaporator. As it supplies heat, the water vapor from the first evaporator condenses. Approximately equal quantities of wastewater are evaporated in each unit; thus, the double effect system evaporates twice the amount of water that a single effect system does, at nearly the same energy cost. The double effect technique is thermodynamically possible because the second evaporator is maintained at lower pressure (high vacuum) and, therefore, lower evaporation temperature. Another means of increasing energy efficiency is vapor recompression (thermal or mechanical), which enables heat to be transferred from the condensing water vapor to the evaporating wastewater. Vacuum evaporation equipment may be classified as sumberged tube or climbing film evaporation units.

In the most commonly used submerged tube evaporator, the heating and condensing coil are contained in a single vessel to reduce capital cost. The vacuum in the vessel is maintained by an ejector-type pump, which creates the required vacuum by the flow of the condenser cooling water through a venturi. Wastewater accumulates in the bottom of the vessel, and is evaporated by means of submerged steam coils. The resulting water vapor condenses as it contacts the condensing coils in the top of the vessel. The condensate then drips off the condensing coils into a collection trough that carries it out of the vessel. Concentrate is also removed from the bottom of the vessel.

The major elements of the climbing film evaporator are the evaporator, separator, condenser, and vacuum pump. Wastewater is "drawn" into the system by the vacuum so that a constant liquid level is maintained in the separator. Liquid enters the steam-jacketed evaporator tubes, and part of it evaporates so that a mixture of vapor and liquid enters the separator. The design of the separator is such that the liquid is continuously circulated from the separator to the evaporator. The vapor entering the separator flows out through a mesh entrainment separator to the condenser, where it is condensed as it flows down through the condenser tubes. The condensate, along with any entrained air, is pumped out of the bottom of the condenser by a liquid ring vacuum pump. The liquid seal provided by the condensate keeps the vacuum in the system from being broken.

## Application and Performance

Both atmospheric and vacuum evaporation are used in many industrial plants, mainly for the concentration and recovery of process solutions. Many of these evaporators also recover water for rinsing. Evaporation has also been used to recover phosphate metal cleaning solutions.

## Advantages and Limitations

Advantages of the evaporation process are that it permits recovery of a wide variety of process chemicals, and it is applicable for concentration or removal of compounds which cannot be accomplished by other means. The major disadvantage is that the evaporation process consumes relatively large amounts of energy. However, the recovery of waste heat from many industrial processes (e.g., diesel generators, incinerators, boilers and furnaces) should be considered as a source of this heat for a totally integrated evaporation system. Also, in some cases solar heating could be inexpensively and effectively applied to evaporation units. For some applications, pretreatment may be required to remove suspended solids or bacteria which tend to cause fouling in the condenser or evaporator. The buildup of scale on the evaporator surfaces reduces the heat transfer efficiency and may present a maintenance problem or increase operating cost. However, it has been demonstrated that fouling of the heat transfer surfaces can be avoided or minimized for certain dissolved solids by precipitate deposition. In addition, low temperature differences in the evaporator will eliminate nucleate boiling and supersaturation effects. Steam distillable impurities in the process stream are carried over with the product water and must be handled by pre or post-treatment.

## Operational Factors

1. Reliability: Proper maintenance will ensure a high degree of reliability for the system. Wthout such attention, rapid fouling or deterioration of vacuum seals may occur, especially when handling corrosive liquids.

2. Maintainability: Operating parameters can be automatically controlled. Pretreatment may be required, as well as periodic cleaning of the system. Regular replacement of seals, especially in a corrosive environment, may be necessary.

### Demonstration Status

Evaporation is a fully developed, commercially available wastewater treatment technology. It is used extensively to recover plating chemicals in the electroplating industry and a pilot scale unit has been used in connection with phosphating of aluminum. Evaporation technology is not used in steel industry applications for wastewater treatment.

## C. In-Plant Controls and Process Modifications

In-plant technology is used in the steel industry to reduce or eliminate the pollutant load requiring end-of-pipe treatment and thereby improve the efficiency of existing wastewater treatment systems or to reduce the requirements of new treatment facilities. In-plant technologies demonstrated in the steel industry includes alternate rinsing procedures, water conservation, reduction of dragout, automatic controls, good housekeeping practices, recycle of untreated process waters and process modifications.

### 1. In-Process Treatment and Controls

In-process treatment and controls apply to both existing and new installations and include existing technologies and operating practices. The data received from the industry indicates that water conservation practices are widely used in many subcategories. Within any particular subcategory process wastewater can vary substantially. In many cases, these variations are directly related to in-process water conservation and control measures. Although the effluent limitations and standards do not regulate flow, they are based upon model flow rates demonstrated in the respective subcategories.

While effective control over operating practices is one method of in-plant control, others are more complex and require greater expenditures of capital. One of these is the installation of cascade rinsing (counter-current) rinsing systems. Cascade rinsing is a demonstrated in-process control for pickling and hot coating operations and may be implemented at other processes that use conventional rinsing techniques.

Another in-process control is the recycle of process water. In several steel industry processes, wastewaters are recycled "in- plant" even prior to treatment. For example, in the cold rolling process, oil emulsions can be collected and returned to the mill in recirculation systems thereby reducing the volumes of wastewater discharged. This control method may not necessarily be used in all processes because of the product quality or recycle system problems that may be encountered.

Other simple in-process controls that can affect discharge quality include good housekeeping practices and automatic equipment. For example, if tight control over the process is maintained and spills are controlled, excessive "dumps" of waste solutions can be averted. Also, automatic controls can be installed that control applied water rates to insure that water is applied only when a mill is actually operating. For mills or lines that are not operated continuously the volume of watar that can be conserved with this practice can be significant.

2. Process Substitutions

There are several instances in the steel industry where process substitutions can be used to effectively control wastewater discharges. One is a cold rolling operations where mills can be designed to operate either in a once-through or recycle mode. If those mills with once-through systems operated in a recycle mode, oil usage would be reduced and savings could be achieved since a smaller treatment system would be required.

Another area where in-process substitutions can achieve significant reductions in wastewater flows and pollutant loads is by selecting dry air pollution control systems over wet systems.

## TABLE VI-1

## TOXIC ORGANIC CONCENTRATIONS ACHIEVABLE BY TREATMENT

| No. | Priority Pollutant | Achievable Concentration(µg/1) |  |
|---|---|---|---|
|  |  | Carbon Adsorption | Biological Oxidation(1) |
| 003 | Acrylonitrile | 200 | 100 |
| 004 | Benzene | 50 | 50 |
| 009 | Hexachlorobenzene | 1 | * |
| 011 | 1,1,1-Trichloroethane | 100 | * |
| 021 | 2,4,6-Trichlorophenol | 25 | 50 |
| 022 | Parachlorometacresol | 50 | * |
| 023 | Chloroform | 20 | 200 |
| 024 | 2-Chlorophenol | 50 | 50 |
| 034 | 2,4-Dimethylphenol | 25 | 5 |
| 035 | 2,4-Dinitrotoluene | 50 | 50 |
| 036 | 2,6-Dinitrotoluene | 50 | 100 |
| 038 | Ethylbenzene | 50 | 25 |
| 039 | Fluoranthene | 10 | 5 |
| 054 | Isophorone | 50 | 100 |
| 055 | Naphthalene | 25 | 5 |
| 057 | 2-Nitrophenol | 25 | 100 |
| 060 | 4,6-Dinitro-o-cresol | 25 | 25 |
| 064 | Pentachlorophenol | 50 | * |
| 065 | Phenol | 50 | 25 |
| 066-071 | Phthalates, Total | 100 | 200 |
| 072 | Benzo(a)anthracene | 10 | 5 |
| 073 | Benzo(a)pyrene | 1 | 5 |
| 076 | Chrysene | 5 | 10 |
| 077 | Acenaphthylene | 10 | 10 |
| 078 | Anthracene | 1 | 1 |
| 080 | Fluorene | 10 | 5 |
| 084 | Pyrene | 10 | 10 |
| 085 | Tetrachlorethylene | 50 | 100 |
| 086 | Toluene | 50 | 50 |
| 130 | Xylene | 10 | 100 |

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* No significant removal over influent level.
(1) Two-stage activated sludge system.

# VOLUME I

# SECTION VII

# DEVELOPMENT OF COST ESTIMATES

## Introduction

This section reviews the Agency's methodology for developing cost estimates for the alternative water pollution control systems considered for each subcategory. The economic impacts due to these costs and to other factors affecting the steel industry are reviewed in the above references report.

## Basis of Cost Estimates

Costs developed for the various levels of treatment (i.e., BPT, BAT, NSPS and Pretreatment) are presented in detail in each subcategory report of the Development Document. Model costs include investment, capital depreciation, land rental interest, operating and maintenance, and energy. The costs for BPT and BAT are summarized and presented in Sections VIII and IX of this report. Costs for PSES are presented in Section XII. Only model costs are presented for NSPS and PSNS while total industry costs are presented for the other levels of control. The Agency did not include estimates of capacity addition in this report. However, estimates of capacity additions, retirements, and reworks are included in Economic Analysis of Effluent Guidelines - Integrated Iron and Steel Industry.

The Agency developed model wastewater treatment systems and cost estimates for those systems. Industry-wide costs to comply with this regulation were determined from application of the costs for the selected model treatment systems to each plant taking into account treatment in place as of a reference date. For each subcategory, the model costs were developed as follows:

1. National annual production and capacity data for each subdivision or segment along with the number of plants in each subdivision were determined. From these data, an "average" plant size was established for each subdivision.

2. For finishing operations, where more than one mill or line of the same operation exists at one plant site, the capacities of these mills or lines were summed to develop a site size and costs for one wastewater treatment facility were developed as noted below. This manner of sizing model plants more accurately represents actual wastewater treatment practices in the industry. Wastewaters from all cold mills at a given site are usually treated in central treatment systems. By using site sizes, where appropriate, wastewater treatment within subcategories was more accurately reflected in the cost estimates.

3. If different product types or steel types within a subcategory were found to have different average sizes, separate cost models were developed to more accurately define the costs for these groupings.

4. Applied model process flow rates were established based upon data obtained from questionnaires and accumulated during field sampling visits. The model flows are expressed in l/kkg or gal/ton of product.

5. A treatment process model and flow diagram was developed for each subcategory based upon appropriate subcategory treatment systems and effluent flow rates representative of the application of established water pollution control practices.

6. Finally, a detailed cost estimate was made on the basis of each alternative treatment system. All cost estimated were developed in July 1978 dollars.

Total annual costs were developed by summing the operating costs (including those for chemicals, maintenance, labor, and energy) and capital recovery costs. Capital recovery costs were calculated using a capital recovery factor (CRF) derived specifically for the steel industry. Separate CRF's were derived for capital investments and for land costs. An explanation of the derivation of these factors is provided below.

The purpose of a capital recovery factor is to annualize capital investment costs over the useful life of an asset. Annualizing capital investment costs using a capital recovery factor procedure should be distinguished from using a depreciation schedule to calculate depreciation expense for accounting purposes. The purpose of a depreciation schedule is to match the historic cost or book value of an investment with accounting revenues occurring over the useful life of the asset. A capital recovery factor indicates the magnitude of a series of periodic cash flows which, over the useful life of the asset, will have a discounted present value equal to the discounted present value of the investment. The discounted present value of an investment is generally not the same as its book value due to the impact of investment tax credits, tax-deductible non-cash expenses such as depreciation, and tax-deductible investment-related expenses such as interest and property taxes.

## Assumption Underlying Capital Recovery Factors

For purposes of this study, it was assumed that pollution control capital expenditures would be financed 20 percent by non-tax exempt corporate debt and 80 percent by tax-exempt industrial revenue bonds. The interest rate on the corporate debt was determined by adding a premium of 2.7 percent to the inflation rate assumed for the period 1981-1982. The tax-exempt interest rate was assumed to be two-thirds of the non-exempt interest rate. A marginal income tax rate of 50.1 percent was assumed, based on a marginal federal rate of 46 percent and a tax-deductible average state tax rate of 7.55 percent. An investment tax credit of 10 percent and the five-year "capital recovery" tax depreciation factors were assumed to apply to investments in pollution control equipment associated with steel mill equipment. A property tax rate of 2.38 percent of net book value was also assumed, based on 14-year straightline depreciation for book purposes.

The capital recovery factor used by the Agency in this report is different from and more appropriate than that used in the December 1980 Development Document. This formula is more appropriate as it accounts for the tax effects of the industry's investment in capital.

## Calculation of Capital Recovery Factors

Given the assumption listed above, the 9.4 percent inflation rate projection for 1981 implies a weighted average interest rate on pollution control debt of 8.91 percent:

$$(9.4 + 2.7)* .2 + .67*(9.4 + 2.7)* .8 = 8.91\%$$

Using the discount rate to calculate the present value of a $1.0 million investment in pollution control equipment yields an estimated present value of -$351,020. Annualizing this outlay over a 14-year period at the assumed rate of interest results in a level annual payment of $44,854 after taxes, which implies an outlay of $89,889 before taxes. Normalizing the before-tax outlay by the initial investment of $1.0 million results in the capital recovery factor for pollution control equipment of 0.0899.

The calculation of an annualized charge for land is slightly diferent because land does not qualify for an investment tax credit and is not a depreciable wasting asset. Instead, land investments are characterized by capital appreciation which is recovered at the and of the investment period. For purposes of this study, the Agency assumed that property taxes would be based on an assessed value rising at the average rate of inflation over the period, and that a recovery or reversion of the appreciated land would occur at the end of the 14-year period. Based upon this assumption, a $1.0 million investment in land financed at the weighted average interest rate used for pollution control equipment would have a present value of -$247,340. Recovery of this cost over a 14-year period would require receiving an annual rent after-tax of $31,660 per year. This corresponds to a before-tax imputed rental of $63,340. Normalizing this imputed rental by the initial investment of $1.0 million yields the required capital recovery factor for land of 0.0634.

## Basis for Direct Costs

Construction costs are highly variable and in order to determine these costs in a consistent manner, the following parameters were established as the basis of estimates. The cost estimates reflect average costs.

1. The treatment facilities are contained within a "battery limit" site location and are erected on a "green field" site. Site clearance costs have been estimated based upon average site conditions with no allowances for equipment relocation. Equipment relocation costs could not be included because equipment relocation is highly site specific and in fact not required at most facilities.

2. Equipment costs for most components are based upon specific effluent water rates and pollutant loads. A change in water flow rates will affect costs. For vacuum filters, costs are based on the square feet ($ft^2$) of surface area of the filter which is a function of the amount of solid waste to be dewatered. Costs for rinse reduction technology (i.e., cascade rinse) is based upon production capacity. For these two components, costs are affected more by these variables than by flow.

3. The treatment facilities are assumed to be located in reasonable proximity to the wastewater source. Piping and other utility costs for interconnecting utility runs from the production facility to the battery limits of the treatment facility are based upon a linear distance estimate of 2500 feet. The Agency considers 2500 ft to be generous for most applications. The cost of return piping is included in recycle system costs.

4. Land acquisition costs are included in the cost estimates prepared for this study. An average land cost of $38,000/acre (1978 dollars) is used to estimate land cost requirements for the model treatment components. Total land costs were then adjusted to represent an annual charge to be incurred over the life or the treatment system by applying the land cost capital recovery factor explained above.

5. Costs for all nessary instrumentation to operate the model wastewater treatment facilities have been included in the Agency's cost estimates, including pH and ORP control, flow meters, level controls, and various vacuum instruments, as appropriate.

6. The Agency's cost estimates include costs for standard safety items including fencing, walkways, guard rails, telephone service, showers, and lighting.

7. The Agency's cost estimates are based upon delivered prices of the water pollution control equipment and related items, thus freight charges are included in the Agency's cost estimates. However, because of the highly variable nature of sales and use taxes imposed by state, regional, country, and local governments, the Agency did not include such taxes in its cost estimates.

8. Control and treatment system buildings are prefabricated buildings; not of brick or block construction.

In general, the cost estimates reflect an on-site installed cost for a treatment plant with electrical substation and equipment for powering the facilities, all necessary pumps, essential controls and instrumentations, treatment plant interconnecting feed pipe lines, chemical feed and treatment facilities, foundations, structural steel, and a control house. Access roadways within battery limits are included in estimates based upon 3.65 cm (1.5 inch) thick bituminous wearing course and 10 cm (4 inch) thick sub-base with sealer, binder, and gravel surfacing. A nine gauge chain link fence with three strand barb wire and one truck gate were included for fencing. The cost estimates also include a 15% contingency fee, 10% contractor's overhead and profit allowance, and engineering fees of 15%.

Sources of cost data for wastewater treatment system components and other direct cost items include vendor quotations and cost manuals commonly used for estimating construction costs. These manuals include:

a - The Richardson Rapid System, Process Plant Contruction Estimating Standards; 1978-1979 Edition; Richardson Engineering Services, Inc.
b - Building Construction Cost Data; 1978; Robert Snow Means Company, Inc.

Basis for Indirect Costs

In addition to developing estimates for individual treatment components, the Agency has also included indirect costs in its total cost estimates for water pollution control equipment. Indirect costs cover such items as engineering expenses, taxes and insurance, contractor's fees and overheads and other miscellaneous expenses. Normally, these indirect costs are represented by three broad expense categories: engineering, overhead and profit, and contingencies.

Cost manuals, vendor quotes and actual installation costs generally show a range for total indirect costs of between 15% and 40% of total direct costs. The Agency's estimates contain indirect cost factors which total 45% of the total direct costs. The factors used by the Agency and an example of how they are applied to direct costs are shown below:

|  | Incremental Costs ($) | Total Cost ($) |
|---|---|---|
| Total Direct Cost | 1,000,000 | 1,000,000 |
| Contingency @ 15% | 150,000 | 1,150,000 |
| Overhead and Profit @ 10% | 115,000 | 1,265,100 |
| Engineering @ 15% | 189,750 | 1,454,750 |
| Total Indirect Costs | 454,750 | (45.5% of direct costs) |

Cost comparisons made between the Agency's estimates and actual installation costs have demonstrated that the Agency's methodology, including its method of applying indirect costs, is proper and can be used to accurately estimate industry-wide costs.

## BPT, BAT, NSPS, PSES and PSNS Cost Estimates

Two cost estimates were made for this study for the BPT, BAT and PSES levels of treatment. The first deals with the capital costs for the systems already installed and the second accounts for the capital costs for the treatment components still required at each of these levels. Additionally, both in-place and required annual costs were calculated and these costs are included in all cost summaries presented in this document.

Because DCP responses were received from all major steel operations and almost all minor steel facilities, the data base on installed treatment components (as of January 1, 1978) was fairly complete. Additionally, the Agency updated the information to July 1, 1981, based upon personal knowledge of EPA Staff, NPDES records, and contact with the industry during the public comment period on the proposed regulation. Using this data base, a plant-by-plant inventory was completed which tabulated the treatment components presently installed and those components which are required to bring the systems up to the BPT, BAT and PSES treatment levels. Hence, an estimate of capital cost requirements was made for each plant and subcategory by scaling individual plants to the developed treatment model and factoring costs based upon production by the "six-tenth factor". By this method, the Agency estimated the expenditures already made by the steel industry. These data were summarized earlier in Section II and are also summarized in each subcategory report.

For NSPS and PSNS, total industry costs have not been presented in this report since predictions of future expansion in the industry were not made as part of this study.

# VOLUME I

# SECTION VIII

# EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

## Introduction

Best Practicable Control Technology Currently Available (BPT) is generally based upon the average of the best existing performances at plants of various sizes, ages, and unit processes within the industrial subcategory. This average is not based upon a broad range of mills within the subcategory, but is based upon performance levels achieved at plants known to be equipped with the best wastewater treatment facilities.

The Agency also considered the following factors:

1. The size and age of equipment and facilities involved.
2. The processes employed.
3. Non-water quality environmental impacts (including sludge generation and energy requirements).
4. The engineering aspects of the applications of various types of control techniques.
5. Process changes.
6. The total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application.

BPT emphasizes treatment facilities at the end of a manufacturing process but can also include control technologies within the process itself when they are considered to be normal practice within the industry.

The Agency also considered the degree of economic and engineering reliability in order to determine whether a technology is "currently available." As a result of demonstrations, projects, pilot plants and general use, the Agency must have a high degree of confidence in the engineering and economic practicability of the technology at the time of commencement of construction or installation of the control facilities.

## Identification of BPT

For the most part, the proposed BPT limitations are the same as those contained in prior steel industry water pollution control regulations. The Agency proposed less stringent limitations where the prior limitations were not being achieved in the industry, or more recent and complete data indicated the prior limitations were not appropriate because of changes in subcategorization or the absence of specific limited pollutants in the respective wastewaters.

The major changes between the proposed BPT limitations and those contained in the prior regulation are summarized below:

| Subcategory | Change: Prior Regulations to Proposed Regulation |
|---|---|
| A. Cokemaking | The suspended solids limitation for cokemaking operations was increased. |
| B. Sintering | All of the limitations for sintering operations were increased based upon increased model treatment system flow rates. |
| D. Steelmaking | Segments were added for BOF wet-suppressed combustion operations. |
| H. Scale Removal | For scale removal operations, the dissolved chromium limitations were changed to total chromium limitations; and, for Kolene® operations, the cyanide limitations were deleted. |
| I. Acid Pickling | For combination acid pickling operations, limitations for dissolved chromium and nickel were changed to total chromium and total nickel. |
| J. Cold Rolling | Separate zero discharge limitations for cold worked pipe and tube operations were proposed. These operations had been included in the subdivision for hot worked pipe and tube operations in prior regulations. |
| K. Alkaline Cleaning | Limitations for dissolved iron, dissolved chromium, and dissolved nickel were deleted for alkaline cleaning operations. |
| L. Hot Coating | Separate limitations were proposed for galvanizing hot coating operations of wire products and fasteners and all hot coating operations using metals other than zinc and terne metal. These operations were not regulated separately in the prior regulation. |

Other than the changes noted above, the Agency proposed the same BPT limitations that were contained in the prior regulations, even though in many instances, more stringent limitations might be justified. The Agency chose this course of action for the following reasons:

1. The technological bases of the prior regulations were upheld by the Court in AISI-I and AISI-II and the Agency believes the limitations and standards are appropriate.

2. For virtually every subcategory, the Agency proposed BAT and BCT limitations more stringent than the proposed BPT limitations. Thus, upon promulgation, the BAT and BCT limitations would become the operative limitations for NPDES permits and, in most cases, the BPT limitations would have little or no impact on the permitting process.

Based upon comments received on the proposed regulation, the Agency has made some substantial changes to the BPT limitations from those that were proposed, particularly for the forming and finishing operations. In some cases, more stringent BPT limitations were promulgated. In other cases, less stringent BPT limitations were promulgated. For the basic steelmaking operations, most of the proposed BPT limitations were promulgated. In all cases, however, the Agency used the same basic model treatment technologies to develop the proposed BPT limitations as were used to develop the final BPT limitations.

The public comments caused the Agency to re-examine the subdivision of each subcategory, in terms of whether or not model treatment system flows based upon product type or operating mode are appropriate, whether or not in-process of end-of-pipe flow reduction systems are appropriate, and, the performance of the model treatment systems in achieving the desired effluent quality. For the basic steelmaking operations, the response to public comments did not cause the Agency to substantially alter its conclusions regarding the appropriateness of the proposed BAT limitations. Thus, upon promulgation of more stringent BAT limitations for these operations, the Agency saw no reason to alter the proposed BPT limitations except where public comments provided compelling evidence that they are too stringent. For many of the forming and finishing operations, the response to public comments caused the Agency to substantially alter the subdivision of the subcategories, change model treatment system flow rates and, reevaluate the performance of the model treatment systems. Also, the Agency found that substantial flow reduction systems included in many of the BAT alternatives are not warranted. Thus, for these operations, the Agency believes that revised BPT limitations are appropriate. Alternatively, the Agency could have promulgated the proposed BPT limitations and more stringent BAT limitations, but chose not to do so because no additional technology would be required to achieve the more stringent BAT limitations; and, the Regulation would be confusing and not in accordance with the Agency's policy of co-treatment of compatible wastewaters.

The Agency revised the BPT limitations for the forming and finishing operations for the following reasons:

1. Based upon data and comments received on the proposed regulation, the Agency decided not to promulgate more stringent BAT limitations in several subcategories (Hot Forming, Salt Bath Descaling (formerly Scale Removal), Cold Rolling, Acid Pickling, Alkaline Cleaning, and part of Hot Coating). Because additional wastewater treatment technology beyond that used to develop the BPT limitations would not be required, the Agency believes it is appropriate to limit those toxic pollutants found in the wastewaters from the respective subcategories at the BPT level.

2. In some cases, the Agency's response to comments involved a complete reevaluation of the new and previously available data for particular subcategories. For some operations, the data demonstrate that the model treatment technologies perform substantially better than indicated by data used to develop the prior regulations (Hot Forming, Acid Pickling, Hot Coating). In the absence of more stringent BAT limitations for these operations, the Agency believes it is appropriate that the BPT limitations are based upon these data. For other operations, the Agency found the subdivision of certain subcategories contained in the proposed regulation is not appropriate (Salt Bath Descaling (formerly Scale Removal), Acid Pickling, Cold Forming, Alkaline Cleaning). Revised subdivision of these subcategories based upon product-related process water requirements or mode of operation was provided.

3. The selection of limited pollutants was modified in several instances to facilitate co-treatment of compatible wastewaters not possible with the proposed BPT limitations; (Salt Bath Descaling (formerly Scale Removal), Acid Pickling, Cold Rolliing, Hot Coating).

The bases for all of these changes is set out in detail in the subcategory reports presented in the development document. A summary is provided below:

| Subcategory | Change-Proposed Regulation to Final Regulation |
|---|---|
| A. Cokemaking | The suspended solids limitations were increased further based upon additional data. A separate segment was provided for merchant cokemaking operations. |
| B. Sintering | All of the sintering limitations were increased further based upon an increase in the model treatment system flow rate. |
| D. Steelmaking | The Open Hearth Semi-Wet segment was deleted. |

|  |  |  |
|---|---|---|
|  |  | Less stringent limitations were promulgated for BOF Wet-Open Combustion and Wet Electric Arc Furnace operations based upon changes in respective model treatment system flow rates. |
| G. | Hot Forming | The limitations for all hot forming operations were revised to reflect actual performance of the model treatment system. |
| H. | Salt Bath Descaling | The Salt Bath Descaling subcategory (formerly Scale Removal) was subdivided differently to take into account product-related process water requirements and modes of operation (batch and continuus). Performance data submitted by the industry were used as a basis for the limitations. |
| I. | Acid Pickling | The Acid Pickling subcategory was treated in the same fashion as the Scale Removal Subcategory. Fume scrubber operations are limited separately on a daily mass basis not related to production rate. |
| J. | Cold Forming | Separate limitations were promulgated for Single Stand Recirculation and Direct Application Cold Rolling Mills. Limitations for two toxic organic pollutants were promulgated for all cold rolling operations. |
| k. | Alkaline Cleaning | The Alkaline Cleaning subcategory has been subdivided to take into account higher process water requirements for both batch and continuous operations. |
| L. | Hot Coating | Limitations for the Hot Coating subcategory were made consistent with those for acid pickling and cold rolling operations to facilitate co-treatment. |

## Development of BPT Limitations

### Model Treatment Systems

As noted above, the Agency used the same model treatment systems to develop the promulgated BPT limitations as were used to develop the prior and proposed BPT limitations. These technologies are installed throughout the industry and are well demonstrated. The model treatment systems are described in detail in the subcategory reports of this development document.

## Model Treatment System Flow Rates

The Agency's approach to developing the BPT limitations based upon the model treatment systems includes specification of a model treatment system effluent flow rate and performance standards for the limited pollutants. The model treatment system flow rates have either been retained from the proposed or prior regulations; or, in several cases revised based upon some of the factors noted above. The Agency has established model treatment system effluent flow rates based upon the best performing plants in each subcategory rather than upon averages of all plants or upon statistically derived flows because, to a large extent, flow rates are within the control of the operator.

For the basic steelmaking operations where recycle of air pollution control system wastewaters or process wastewaters is an integral part of the model treatment systems, the "average of the best" blowdown rates or recycle rates formed the basis for the model treatment system effluent flow rates used to develop the BPT limitations. The hot forming operations were evaluated in much the same fashion in that the primary scale pit recycle rates and thus the model treatment system effluent flow rate for each subcategory were determined from the average of the best or most appropriate recycle rates.

For the other finishing operations, the Agency used two approaches for developing the model treatment system effluent flow rates. Production weighted flow rates were developed by product for Salt Bath Descaling and Acid Pickling operations. As noted above, the Agency substantially revised the subdivision of these subcategories to take into account product related rinsewater flow requirements. In doing so, the Agency believes that production weighted flows are appropriate because it could not develop discreet groups of the best plants in each segment. Thus, the production weighted flow provides the best measure of a model plant. For Cold Rolling, Alkaline Cleaning, and Hot Coating operations, the average of the best discharge flows were used to establish the model BPT effluent flow rates. The Agency believes the "average of the best" flows for these operations are appropriate because it could identify the best plants. In any event, in all but a few cases, the production weighted average flow rates for these operations are about the same as, or less than, the "average of the best" flow rates.

The development of the respective model treatment system flow rates is set out in detail in each subcategory report.

## Model Treatment System Effluent Quality

The Agency used the model treatment system effluent flow rates and performance standards for the limited pollutants to develop the BPT limitations. The development of the performance standards for the limited pollutants is presented in Appendix A. In several cases, particularly in the forming and finishing operations, the Agency used data from central treatment facilities that treat compatible wastewaters to establish and demonstrate compliance with the BPT limitations. The Agency believes use of central treatment plant data for these purposes is appropriate because it is consistent with the manner in which the Agency structured the Regulation with respect to co-treatment of compatible wastewaters and is consistent with current treatment practices in the industry.

## BPT Effluent Limitations

Table I-2 summarizes the 1974 and 1976 BPT limitations, along with the changes that have been made and the requirements of the promulgated regulation. Where no changes are noted, the limitations are the same as the original limitations. The guidelines are based on mass limitations in kilograms per 1000 kilograms (lbs/1000 lbs) except for fume scrubbers at acid pickling and hot coating operations where the limitations are in kg per day. As noted earlier, these mass limitations do not require the attainment of any particular discharge flow or effluent concentration. There are virtually an infinite number of combinations of flow and concentration that can be used to achieve the appropriate limitations. This is illustrated in Figure VIII-1 which shows the BPT limitation for suspended solids for the Blast Furnace subcategory. Also shown on this figure, are the relative positions of the sampled plants, some of which are in compliance and some of which did not achieve the limitations. As shown by this diagram, those plants that do not presently achieve the discharge limitation could do so by reducing either discharge flow or effluent concentration, or a combination of the two.

## Costs to Achieve the BPT Limitations

Based upon the cost estimates developed by the Agency, the industry-wide investment costs to achieve full compliance with the BPT limitations is approximately $1.7 billion (in July 1, 1978 dollars). The Agency estimates that as of July 1, 1981, about $0.21 billion of this amount remained to be spent by the industry. The total annual cost associated with the BPT regulation is about $0.20 billion. A breakdown of these BPT costs by subcategory is presented in Table VIII-1. The Agency believes that the effluent reduction benefits resulting from compliance with the BPT limitations justify the associated costs.

These costs are different than those presented in the Draft Development Document. As noted earlier, the Agency updated the status of the industry with respect to the installation of pollution control facilities from January 1978 to July 1981. Also, the installed and required costs for production facilities shut down during the mid to late 1970's were deleted. These facilities were included in the data base for the proposed regulation. The above estimates do not include costs for treatment facilities installed by the industry which are not required to achieve the BPT limitations or for facilities installed which provide treatment more stringent than required to achieve the BPT and BAT limitations (e.g. cascade rinse and acid recovery systems for acid pickling operations; high rate recycle for hot forming operations).

## TABLE VIII-1

## BPT COST SUMMARY
## IRON AND STEEL INDUSTRY

| | Capital | | Annual | |
|---|---|---|---|---|
| Subcategory/Subdivision | In-place | Required | In-Place | Required |
| A. Cokemaking | | | | |
| 1. I&S - Biological | 96.98 | 41.50 | 25.45 | 9.51 |
| 2. I&S - Physical-Chemical | 1.84 | 3.70 | 0.55 | 0.88 |
| 3. Merchant - Biological | 19.43 | 2.45 | 4.08 | 0.54 |
| 4. Merchant - Physical-Chemical | 2.69 | 0.00 | 0.59 | 0.00 |
| 5. Beehive | 0.78 | 0.00 | 0.13 | 0.00 |
| *Cokemaking Total | 121.72 | 47.65 | 30.80 | 10.93 |
| B. Sintering | 58.82 | 5.07 | 12.10 | 1.34 |
| C. Ironmaking | 412.34 | 22.40 | 52.53 | 2.74 |
| D. Steelmaking | | | | |
| 1. BOF: Semi-Wet | 2.70 | 1.61 | 0.41 | 0.24 |
| 2. BOF: Wet-SC | 15.81 | 0.00 | 4.22 | 0.00 |
| 3. BOF: Wet-OC | 57.20 | 1.42 | 13.30 | 0.34 |
| 4. Open Hearth | 17.78 | 0.00 | 3.75 | 0.00 |
| 5. EAF: Semi-Wet | 0.79 | 0.22 | 0.13 | 0.03 |
| 6. EAF: Wet | 14.48 | 0.00 | 2.82 | 0.00 |
| *Steelmaking Total | 108.76 | 3.25 | 24.63 | 0.61 |
| E. Vacuum Degassing | 20.43 | 7.47 | 2.99 | 1.11 |
| F. Continuous Casting | 59.55 | 4.84 | 8.62 | 0.76 |
| G. Hot Forming | | | | |
| 1. Primary C w/s | 76.45 | 20.78 | -29.62 | 2.68 |
| 2. Primary C wo/s | 34.15 | 9.85 | -5.29 | 1.32 |
| 3. Primary S w/s | 6.74 | 0.00 | -0.75 | 0.00 |
| 4. Primary S wo/s | 6.49 | 0.76 | -0.15 | 0.00 |
| 5. Section Carbon | 88.95 | 19.05 | -0.96 | 2.48 |
| 6. Section Spec | 13.28 | 4.17 | -0.15 | 0.30 |
| 7. Flat C HS&S | 102.04 | 23.26 | -4.83 | 3.06 |
| 8. Flat S HS&S | 5.05 | 0.14 | 0.23 | 0.02 |
| 9. Flat C Plate | 13.66 | 6.49 | -1.23 | 0.87 |
| 10. Flat S Plate | 3.01 | 0.18 | 0.07 | 0.02 |
| 11. Pipe & Tube-Carbon | 12.76 | 9.35 | 1.42 | 1.23 |
| 12. Pipe & Tube-Spec | 3.68 | 0.00 | 0.27 | 0.00 |
| *Hot Forming Total | 366.26 | 94.03 | -40.99 | 11.98 |

TABLE VIII-1
BPT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

| Subcategory/Subdivision | Capital | | Annual | |
|---|---|---|---|---|
| | In-place | Required | In-Place | Required |
| H. Salt Bath Descaling | | | | |
| 1. Oxidizing - B S/P | 0.58 | 0.20 | 0.08 | 0.03 |
| 2. Oxidizing - B R/W/B | 0.86 | 0.02 | 0.13 | 0.00 |
| 3. Oxidizing - B P/T | 0.76 | 0.00 | 0.11 | 0.00 |
| 4. Oxidizing - Cont | 1.53 | 0.16 | 0.23 | 0.02 |
| 5. Reducing - Batch | 0.61 | 0.00 | 0.09 | 0.00 |
| 6. Reducing - Cont | 0.20 | 0.00 | 0.03 | 0.00 |
| *Salt Bath Descaling Total | 4.54 | 0.38 | 0.67 | 0.05 |
| I. Acid Pickling | | | | |
| 1. Sulfuric-R/W/C-Neut | 12.96 | 0.51 | 3.37 | 0.13 |
| 2. Sulfuric-S/S/P-Neut | 21.30 | 1.86 | 13.13 | 1.23 |
| 3. Sulfuric-B/B/B-Neut | 9.22 | 0.00 | 2.93 | 0.00 |
| 4. Sulfuric-P/T/O-Neut | 7.55 | 0.42 | 1.92 | 0.08 |
| 5. Sulfuric-S/S/P Au | 3.55 | 0.00 | 0.54 | 0.00 |
| 6. Sulfuric-R/W/C Au | 3.75 | 0.00 | 0.58 | 0.00 |
| 7. Sulfuric-B/B/B Au | 0.66 | 0.00 | 0.00 | 0.00 |
| 8. Sulfuric-P/T Au | 0.77 | 0.00 | 0.12 | 0.00 |
| 9. Hydrochloric-R/W/C | 3.70 | 0.15 | 0.75 | 0.02 |
| 10. Hydrochloric-S/S/P | 35.81 | 1.65 | 22.87 | 1.46 |
| 11. Hydrochloric-P/T | 0.85 | 0.10 | 0.19 | 0.01 |
| 12. Hydrochloric-S/S/P Ar | 15.00 | 0.00 | -4.87 | 0.00 |
| 13. Combination-R/W/C | 5.70 | 0.14 | 1.54 | 0.02 |
| 14. Combination-B S/S/P | 3.17 | 0.03 | 0.74 | 0.00 |
| 15. Combination-C S/S/P | 17.49 | 0.08 | 6.54 | 0.02 |
| 16. Combination-B/B/B | 0.61 | 0.00 | 0.20 | 0.00 |
| 17. Combination-P/T | 2.56 | 0.44 | 0.61 | 0.08 |
| *Acid Pickling Total | 144.65 | 5.38 | 51.16 | 3.05 |
| J. Cold Forming | | | | |
| 1. CR-Recirc Single | 0.56 | 0.54 | 0.08 | 0.08 |
| 2. CR-Recirc Multi | 4.22 | 1.61 | 0.12 | 0.28 |
| 3. CR-Combination | 7.57 | 0.00 | 1.29 | 0.00 |
| 4. CR-DA Single | 3.68 | 0.33 | 0.53 | 0.05 |
| 5. CR-DA Multi | 6.59 | 2.61 | 0.77 | 0.44 |
| 6. CW Pipe&Tube Water | 3.30 | 0.76 | 0.43 | 0.10 |
| 7. CW Pipe & Tube Oil | 3.06 | 0.02 | 0.40 | 0.00 |
| *Cold Forming Total | 28.98 | 5.87 | 3.62 | 0.95 |

TABLE VIII-1
BPT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

| Subcategory/Subdivision | Capital In-place | Capital Required | Annual In-Place | Annual Required |
|---|---|---|---|---|
| K. Alkaline Cleaning | | | | |
| 1. Batch | 1.67 | 0.31 | 0.21 | 0.04 |
| 2. Continuous | 10.01 | 0.27 | 1.39 | 0.04 |
| *Alkaline Cleaning Total | 11.68 | 0.58 | 1.60 | 0.08 |
| L. Hot Coating | | | | |
| 1. Galv. SS wo/s | 9.87 | 1.47 | 1.48 | 0.26 |
| 2. Galv. SS w/s | 9.80 | 0.44 | 1.55 | 0.08 |
| 3. Galv. Wire wo/s | 5.44 | 0.66 | 0.69 | 0.10 |
| 4. Galv. Wire w/s | 1.10 | 0.66 | 0.17 | 0.10 |
| 5. Terne wo/s | 0.52 | 0.05 | 0.07 | 0.01 |
| 6. Terne w/s | 1.32 | 0.32 | 0.20 | 0.05 |
| 7. Other SS wo/s | 0.73 | 1.00 | 0.11 | 0.16 |
| 8. Other SS w/s | - | - | - | - |
| 9. Other Wire wo/s | 0.31 | 0.00 | 0.04 | 0.00 |
| 10. Other Wire w/s | 0.74 | 0.00 | 0.00 | 0.00 |
| *Hot Coating Total | 29.83 | 4.60 | 4.31 | 0.76 |
| Total | 1,367.56 | 201.52 | 152.04 | 34.36 |
| Confidential Plants | 39.83 | 4.44 | 4.98 | 0.91 |
| Costs for Components Installed Beyond BPT | 84.10 | 0.00 | 11.71 | 0.00 |
| Industry Total | 1,491.49 | 205.96 | 168.73 | 35.27 |

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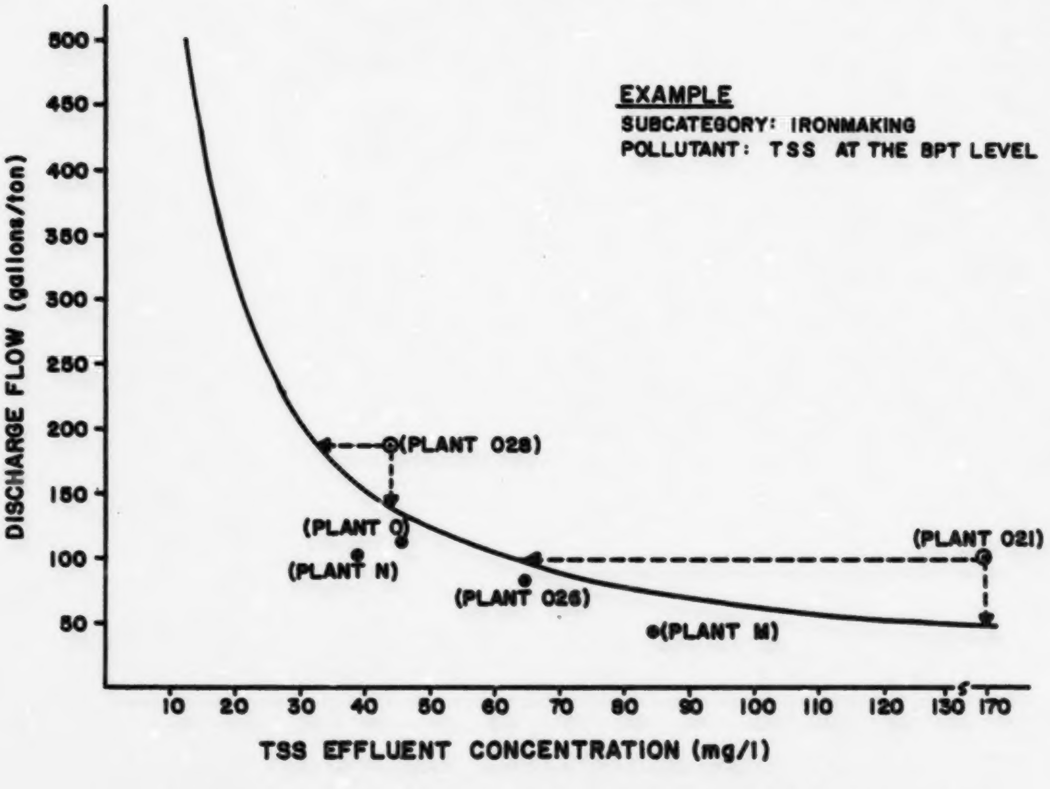
NOTES: Costs are in millions of 7/1/78 dollars.
Basis: Facilities in-place as of 7/1/81.

FIGURE VIII-1
POTENTIAL FOR ACHIEVING
AN EFFLUENT LIMITATION



——: SOLID LINE REPRESENTS TSS LIMIT OF 0.026 kg/kkg (lbs/1000 lbs)

NOTE: PLANTS ABOVE THE SOLID LINE DO NOT MEET TSS LIMITATIONS. HOWEVER, THEY COULD ATTAIN THE APPROPRIATE LOAD BY EITHER REDUCING THEIR FLOW OR EFFLUENT CONCENTRATION AS SHOWN BY THE DASHED ARROWS OR ANY COMBINATION OF THE TWO.

## SECTION IX

## EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

### Introduction

The effluent limitations which must be achieved by July 1, 1984 are to specify the degree of effluent reduction attainable through the application of the best available technology economically achievable. Best available technology is not based upon an "average of the best" performance within an industrial category, but is determined by identifying the best control and treatment technology used by a specific point source within the industrial subcategory. Also, where a technology is readily transferable from one industry to another, such technology may be identified as BAT technology.

Consideration was also given to:

1. The size and age of equipment and facilities involved.
2. The processes employed.
3. Non-water quality environmental impact (including energy requirements).
4. The engineering aspects of the application of various types of control techniques.
5. Process changes.
6. The cost of achieving the effluent reduction resulting from application of BAT technology.

Best available technology may be the highest degree of control technology that has been achieved or has been demonstrated to be capable of being designed for plant scale operation up to and including "no discharge" of pollutants. Although economic factors are considered in the development, the level of control is intended to be the top-of-the-line current technology, subject to limitations imposed by economic and engineering feasibility. However, this level may be characterized by some technical risk with respect to performance and with respect to certainty of costs.

## Development of BAT Effluent Limitations

### Model Treatment Systems

The Agency considered from two to five BAT alternative treatment systems for each of the twelve steel industry subcategories. These alternatives are designed to be compatible with the BPT model treatment systems in each subcategory from the standpoint of retrofitting the necessary water pollution control facilities. For those operations where BAT limitations more stringent than the respective BPT limitations have been promulgated, the required water pollution control facilities can be installed, without significant retrofit costs. For most subcategories (Sintering, Ironmaking, Steelmaking, Vacuum Degassing, and Continuous Casting), flows amounting to only a few percent of the model BPT treatment system flow rates require treatment in the BAT model treatment systems. For cokemaking operations, additional biological treatment compatible with the BPT model biological treatment system is the model BAT technology. The BAT alternative treatment systems are reviewed in detail in the respective subcategory reports of the development documents.

### Model Treatment System Flow Rates

The Agency's selection of model BAT flow rates is highly subcategory specific. In every case the Agency sought to determine the best flow rate that could be achieved on a subcategory wide basis. In some cases, the model BAT flow rates for the alternative treatment systems are significantly more restrictive than the respective model BPT flow rates. However, for most forming and finishing operations, where more stringent BAT limitations were not promulgated, the model BAT flow rates are the same as the model BPT flow rates. The Agency considered zero discharge alternatives based upon evaporative technologies in all subcategories. These technologies were rejected because of energy and cost considerations.

A summary of the model BPT and BAT effluent flow rates for those operations where more stringent BAT limitations were promulgated is presented below:

| Subcategory | Model BPT Flow Rate | Model BAT Flow Rate |
|---|---|---|
| A. Cokemaking | | |
| Iron and Steel | 225 gal/ton | 153 gal/ton |
| Merchant | 240 | 170 |
| b. Sintering | 120 | 120 |
| C. Ironmaking | 125 | 70 |
| D. Steelmaking | | |
| BOF, semi-wet | 0 | 0 |
| BOF, wet-supp. comb. | 50 | 50 |

| | | | |
|---|---|---|---|
| | BOF, wet-open comb. | 110 | 110 |
| | Open Hearth, wet | 110 | 110 |
| | EAF, semi-wet | 0 | 0 |
| | EAF, wet | 110 | 110 |
| E. | Vacuum Degassing | 25 | 25 |
| F. | Continuous Casting | 125 | 25 |
| L. | Hot Coating Fume Scrubbers | 100 gpm | 15gpm |

The lower BAT model flow rates for cokemaking operations are based upon recycle of barometric condenser cooling water, or replacement of the barometric condenser with a surface condensor. The ironmaking BAT model flow was set at 70 gal/ton based upon demonstrated performance at plants in this subcategory. The BAT model flow rate for continuous casting operations was set at 25 gal/ton based upon widespread demonstration of flows of 25 gal/ton and less in that subcategory. Finally, the hot coating fume scrubber BAT model flow of 15 gpm is based upon recycle of fume scrubber wastewaters, a common practice in the industry. The Agency did not set more restrictive BAT model flow rates for the other operations listed above because it does not have sufficient information and data at this time to demonstrate that more restrictive flow rates are achievable on a subcategory-wide basis. Reference is made to the respective subcategory reports for additional information on the selection of the BAT model treatment system flow rates.

### Model Treatment System Effluent Quality

The performance standards for the model BAT treatment systems were determined in the same fashion as described in Section VIII for the BPT limitations. Where more stringent BAT limitations were promulgated, the Agency based the limitations upon the best performing representative plant or plants in the subcategory; upon pilot scale demonstration studies at plants within the subcategory; or upon pilot scale demonstration studies at plants with similar, more highly contaminated wastewaters. In all cases, however, the BAT limitations are achieved on a full scale basis in the industry.

### Summary of Changes From Proposed Regulation

Based upon comments on the proposed regulation, the Agency made several changes in promulgating the final BAT effluent limitations.

For the most part, BAT effluent limitations more stringent than the BPT limitations were promulgated for the basic steelmaking operations and BAT limitations no more stringent than the BPT limittaions were promulgated for the forming and finishing operations. These changes are summarized below:

| Subcategory | Changes from Proposed to Promulgated Regulation |
|---|---|
| A. Cokemaking | While the model BAT treatment systems have not changed substantially, slightly less stringent limitations for all pollutants were promulgated based upon analysis of additional data received for the best treatment facilities. |
| B. Sintering | The selected model technology was changed from alkaline chlorination to filtration. Limitations for ammonia-N, total cyanide, and phenols (4AAP) were provided for sintering operations with wastewaters that are co-treated with ironmaking wastewaters. |
| C. Ironmaking | Less stringent ammonia-N limitations were promulgated on the basis of comments and data received on the proposed limitations. |
| D. Steelmaking | The selected model technology was changed to delete post filtration of the lime precipitation effluent. Slightly less stringent limitations for lead and zinc were promulgated and the limitations for chromium were deleted. |
| E. Vacuum Degassing<br>F. Continuous Casting | The model treatment technology was changed to lime precipitation and sedimentation from filtration. Less stringent limitations for lead and zinc were promulgated and the limitation for chromium was deleted. The limitations for these operations are now consistent with those for steelmaking operations. |
| G. Hot Forming | High rate recycle of hot forming wastewaters was not selected as the model BAT treatment technology. Thus, BAT limitations for hot forming operations were not promulgated. |
| H. Salt Bath Descaling | Filtration of the BPT model treatment system effluent was not selected as the model BAT treatment system. Thus, BAT limitations no more stringent than the BPT limitations were promulgated. |

| | | |
|---|---|---|
| I. | Acid Pickling | Cascade rinsing of acid pickling rinsewaters was not selected as the BAT model treatment system. Thus, BAT limitations no more stringent than the BPT limitations were promulgated. |
| J. | Cold Forming | BAT limitations no more stringent than the BPT limitations were promulgated. |
| K. | Alkaline Cleaning | BAT limitations were not proposed and not promulgated. |
| L. | Hot Coating | Cascade rinsing of hot coating rinsewaters was not selected as the model BAT treatment technology. BAT limitations no more stringent than the BPT limitations were promulgated for those hot coating operations without fume scrubbers. More stringent BAT limitations were promulgated for those hot coating operations with fume scrubbers. |

## Best Available Technology Effluent Limitations and Associated Costs

Based upon the information contained in Sections II through VIII of this report and upon data presented in the respective subcategory reports, various treatment systems were considered for the BAT level of treatment. A short description of the model BAT treatment systems is presented in Table I-15. The BAT effluent limitations are summarized in Table I-4. The costs associated with the model BAT systems are summarized in Table IX-14 by subcategory. As with the BPT effluent limitations, the Agency has concluded that the effluent reduction benefits associated with the selected BAT limitations justify the costs and non-water quality environmental impacts, including energy consumption, water consumption, air pollution, and solid waste generation.

## Co-Treatment with Non-Steel Industry Finishing Wastewaters

The steel industry produces a number of finished products that are coated with various metals for protective or decorative purposes. This regulation contains effluent limitations and standards for the hot coating processes (i.e., coating of steel by immersion in molten baths of zinc, terne metal, or other metals). However, the regulation does not include specific limitations for cadmium, copper, chromium, nickel, tin, and zinc electroplating operations found at many steel plants. It is common practice in the industry to co-treat wastewaters from these operations with wastewaters from acid pickling, cold rolling, alkaline cleaning, and hot coating operations. Often, pretreatment of wastestreams with high levels of cyanide or a particular metal is practiced prior to final neutralization and settling (i.e., reduction of hexavalent chromium; separate neutralization and settling for zinc). The model BPT and BAT treatment systems for steel industry finishing operations are installed at many co-treatment plants and, effluent data from some of the co-treatment systems were considered in developing the limitations and standards in this regulation.

Application of the limitations and standards contained in this regulation to plants with electroplating operations without any allowance for those operations will present problems, both to permit writers and to the industry. The following guidance is provided to permit writers to develop plant specific NPDES permit conditions for these facilities:

a. Treatment Plants with BPT/BAT Treatment Facilities In-Place
   1) Determine the plant specific BPT/BAT effluent limitations for those steel industry finishing operations included in this regulation. Compare the mass loadings to current performance of the treatment facility in question for periods of relatively high production.
   2) If the applicable effluent limitations for the steel operations included in this regulation are determined not to be achievable considering appropriate historical performance data, alternate BAT limitations should be developed for those plants with well operated treatment facilities. These treatment facilities should include all of the BPT/BAT treatment components and not include a substantial amount of cooling waters, surface runoff, or process wastewaters from hot forming or any of the basic steelmaking operations. These alternate mass effluent limitations should be based upon the current performance of the treatment facility on a concentration basis, and treatment system flow rates which take into account those finishing operations included in this regulation and flows from the electroplating operations. In some cases, in-process flow reduction including recycle of fume scrubbers, reduction in rinsewater flows, etc., may be required to further reduce the discharge from current levels. In general, the concentrations determined from actual performance data should be in the immediate range of those concentrations presented in the Development Document used to develop the BPT and BAT effluent limitations.

b. Treatment Plants Without BPT/BAT Treatment Facilities In-Place
   1) Determine the plant specific BPT/BAT effluent limitations for those steel industry finishing operations included in this regulation.
   2) Determine an allowance for the electroplating operations based upon the process flow rates from those operations (after appropriate flow minimization steps are implemented i.e., fume scrubber recycle), and the

performance data presented in the Development Document for similar co-treatment systems.

Technical assistance for permit writers may be obtained from the Effluent Guidelines Division for developing limitations for treatment systems that treat wastewaters from operations covered by this regulation and wastewaters from other operations.

## TABLE IX-1

## BAT COST SUMMARY
## IRON AND STEEL INDUSTRY

|  | Capital |  | Annual |  |
|---|---|---|---|---|
| Subcategory/Subdivision | In-place | Required | In-Place | Required |
| A. Cokemaking |  |  |  |  |
| 1. I&S - Biological | 4.83 | 28.62 | 0.92 | 6.96 |
| 2. I&S - Physical-Chemical | 3.74 | 0.00 | 1.62 | 0.00 |
| 3. Merchant - Biological | 0.39 | 4.33 | 0.07 | 0.94 |
| 4. Merchant - Physical-Chemical | 2.16 | 0.00 | 0.98 | 0.00 |
| *Cokemaking Total | 11.12 | 32.95 | 3.59 | 7.90 |
| B. Sintering | 0.51 | 5.51 | 0.05 | 0.74 |
| C. Ironmaking | 7.63 | 23.20 | 2.27 | 6.77 |
| D. Steelmaking |  |  |  |  |
| 1. BOF: Semi-Wet | - | - | - | - |
| 2. BOF: Wet-SC | 1.20 | 0.34 | 0.16 | 0.06 |
| 3. BOF: Wet-OC | 0.56 | 5.32 | 0.08 | 0.78 |
| 4. Open Hearth | 0.33 | 1.44 | 0.05 | 0.23 |
| 5. EAF: Semi-Wet | - | - | - | - |
| 6. EAF: Wet | 0.46 | 1.09 | 0.06 | 0.17 |
| *Steelmaking Total | 2.55 | 8.19 | 0.35 | 1.24 |
| E. Vacuum Degassing | 0.20 | 2.82 | 0.03 | 0.39 |
| F. Continuous Casting | 0.82 | 2.23 | 0.11 | 0.31 |
| L. Hot Coating |  |  |  |  |
| 1. Galv. SS wo/s | - | - | - | - |
| 2. Galv. SS w/s | 0.31 | 0.32 | 0.04 | 0.04 |
| 3. Galv. Wire wo/s | - | - | - | - |
| 4. Galv. Wire w/s | 0.04 | 0.03 | 0.01 | 0.00 |
| 5. Terne wo/s | - | - | - | - |
| 6. Terne w/s | 0.00 | 0.16 | 0.00 | 0.02 |
| 7. Other SS wo/s | - | - | - | - |
| 8. Other SS w/s | - | - | - | - |
| 9. Other Wire wo/s | - | - | - | - |
| 10. Other Wire w/s | 0.10 | 0.00 | 0.00 | 0.00 |
| *Hot Coating Total | 0.45 | 0.51 | 0.05 | 0.06 |
| Total | 23.28 | 75.41 | 6.45 | 17.41 |
| Confidential Plants | 0.80 | 1.94 | 0.18 | 0.43 |
| Industry Total | 24.08 | 77.35 | 6.63 | 17.84 |

---

NOTES: Costs are in millions of 7/1/78 dollars.
Basis: Facilities in-place as of 7/1/81.
: BAT limitations equal to BPT are being promulgated in the other subcategories/subdivisions. There is no additional costs in these subcategories/subdivisions.

## TABLE IX-2

## ADVANCED TREATMENT SYSTEMS CONSIDERED FOR BAT IRON AND STEEL INDUSTRY

| Advanced Treatment System | Coke-making | Sintering | Iron-making | Basic Oxygen Furnace | Open Hearth | Electric Arc | Vacuum Degassing | Cont. Casting | Hot Forming | Salt Bath Descaling | H2SO4 Pickling | HCL Pickling | Comb Pickling | Cold Forming | Alkaline Cleaning | Hot Coating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acid Recovery/ Regeneration | | | | | | | | | | | X | X | | | | |
| Activated Sludge System | X | | | | | | | | | | | | | | | |
| 2 Stage Chlorination | | X | X | | | | | | | X | | | | | | |
| Rinse Reduction System | | | | | | | | | | | X | X | X | | | X |
| Evaporation | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Evaporation as Quench | X | | | | | | | | | | | | | | | |
| Evaporation on Slag | | | X | | | | | | | | | | | | | |
| Filtration (Pressure or Gravity) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Granular Carbon Columns | X | X | X | | | | | | | | | | | X | | |
| Lime Precipitation | | X | X | X | X | X | X | X | | | | | | | | |
| Powdered Carbon Addition | X | | | | | | | | | | | | | X | | |
| Recycle System | X | X | X | X | X | X | | | X | | X | X | X | | | X |
| Sulfide Precipitation | | X | X | X | X | X | X | X | X | X | X | X | X | | | X |

# VOLUME I

# SECTION X

# BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

## Introduction

The 1977 Amendments added Section 301(b)(2)(E) to the Act, establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(a)(4) [biochemical oxygen demanding pollutants ($BOD_5$), total suspended solids (TSS), fecal coliform, and pH], and any additional pollutants defined by the Administrator as "conventional" (oil and grease, 44 FR 44501, July 30, 1979).

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. American Paper Institute v. EPA, 660 F. 2d 954 (4th Cir. 1981). The first test compares the cost for private industry to reduce its conventional pollutants with the costs at publicly owned treatment works for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BAT be less stringent than BPT.

Because of the remand in American Paper Institute v. EPA (No. 79-115), the regulation does not contain BCT limitations except for those operations for which the BAT limitations are not more stringent than the respective BPT limitations.

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## VOLUME I

## SECTION XI

## EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS

### Introduction

NSPS are to specify the degree of effluent reduction achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where applicable, a standard requiring no discharge of pollutants.

For new source plants, a zero discharge of pollutants limit was sought for each subcategory. There are several facilities in some subcategories that demonstrate zero discharge. However, the Agency determined that for most of these subcategories zero discharge is not attainable for all new sources without the use of costly evaporative technologies. For these wastewater operations, treatment systems at lowest achievable flow rates have been considered.

Because new plants can be designed with water conservation and innovative technology in mind, costs can be minimized by treating the lowest possible wastewater flows. No considerations had to be given to the "add-on" approach that was characteristic of the BPT and BAT systems and therefore the NSPS Alternatives consider the most efficient treatment components and systems. NSPS systems are generally the same as the BAT systems; however, in some subcategories, alternate treatment components are included.

### Identification of NSPS

The alternative treatment systems considered for NSPS are the same as the alternatives considered for BAT with minor exceptions. However, as noted above, in many subcategories lower discharge flows are considered for NSPS. Since the criteria for NSPS is to consider only the very best systems, the lowest demonstrated flow could be used to develop NSPS standards. Table XI-1 lists the treatment systems used as models for NSPS. The standards associated with the model NSPS systems are summarized in Table I-15. Additional details on the development of NSPS are provided in the individual subcategory reports. All of the NSPS are demonstrated in the steel industry.

### NSPS Costs

The Agency did not estimate the number of new source plants to be built. However, the Agency did consider the potential economic impacts of NSPS in Economic Analysis of Effluent Guidelines -

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Integrated Iron and Steel Industry. Model costs for the NSPS systems are detailed in the individual subcategory reports.

# VOLUME I

## SECTION XII

## PRETREATMENT STANDARDS FOR PLANTS DISCHARGING TO PUBLICLY OWNED TREATMENT WORKS

### Introduction

The industry discharges untreated or partially treated wastewaters to publicly owned treatment works (POTWs) from operations in nearly every subcategory. Table XII-1 lists all plants which reported discharges to POTWs. In the individual subcategory reports, two classes of discharges to POTWs were addressed: existing sources and new sources. Also, the national pretreatment standards developed for indirect discharges fall into two separate groups: prohibited discharges, covering all POTW users, and categorical standards applying to specific industrial subcategories.

As was done for BAT, BCT and NSPS, various alternative treatment systems were considered for pretreatment standards. Up to six alternatives were considered for each subcategory.

### National Pretreatment Standards

The Agency has developed national standards that apply to all POTW discharges. For detailed information on the Agency's approach to Pretreatment Standards refer to 46 FR 9404 et seq, "General Pretreatment Regulations for Existing and New Sources of Pollution, (January 28, 1981). See also 47 FR 4518 (February 1, 1982). In particular, Part 403, Section 403.5 et. seq. describes national standards, prohibited discharges and categorical standards, POTW pretreatment programs, and a national pretreatment strategy.

### Categorical Pretreatment Standards

The Agency based the categorical pretreatment standards for the steel industry on the minimization of pass through of toxic pollutants at POTWs. For each subcategory, the Agency compared the removal rates for each toxic pollutant limited by the PSES to the removal rate for that pollutant at well operated POTWs. The POTW removal rates were determined through an extensive study conducted by the Agency at over forty POTWs. The POTW removal rates are presented below:

| Toxic Pollutant | POTW Removal Rate |
|---|---|
| Cadmium | 38% |
| Chromium | 65% |
| Copper | 58% |
| Lead | 48% |
| Nickel | 19% |

| | |
|---|---|
| Silver | 66% |
| Zinc | 65% |
| Cyanide | 52% |

As shown in the respective subcategory reports, the pretreatment alternatives selected by the Agency in all cases provide for significantly more removal of toxic pollutants than would occur if steel industry wastewaters were discharged to POTWs untreated. Thus, the pass through of these pollutants at POTWs will be minimized. Except for the Cokemaking subcategory, all selected PSES and PSNS alternatives are the same as the respective BAT and NSPS alternatives. For cokemaking operations, the Agency's selected PSES alternative is based upon the same physical/chemical pretreatment the industry provides for its on-site coke plant biological treatment systems.

The PSES and PSNS are set out in Tables I-8 and I-6, respectively. The associated industry-wide PSES costs are presented in Table XII-14. PSNS model treatment system costs are presented in the respective subcategory reports.

# TABLE XII-1
# LIST OF PLANTS WITH INDIRECT DISCHARGES TO POTW SYSTEMS

| PLANT | COKEMAKING | SINTERING | IRONMAKING | B.O.F. STEELMAKING | O.H. STEELMAKING | E.A.F. STEELMAKING | VACUUM DEGASSING | CONTINUOUS CASTING | HOT FORMING-PRIMARY | HOT FORMING-SECTION | HOT FORMING-FLAT | HOT FORMING-PIPE & TUBE | SALT BATH DESCALING-OXIDIZING | SALT BATH DESCALING-REDUCING | SULFURIC ACID PICKLING | HYDROCHLORIC ACID PICKLING | COMBINATION ACID PICKLING | COLD ROLLING | COLD FORMING-PIPE & TUBE | ALKALINE CLEANING | HOT COATINGS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0020B | | | | | | | | | | | | | | | | | | X | | | | | |
| 0020C | | | | | | | | | | | | | | | | | | X | | | | | |
| 0024A | X | | | | | | | | | | | | | | | | | | | | | | |
| 0048D | | | | | | | | | | | | | | | X | | | | | | | | |
| 0048F | | | | | | | | | | | | | | | X | | | | | | | | |
| 0060 | X | | | | | | | | | | | | | | | | | | | | | | |
| 0060G | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0060H | | | | | | | | X | | | | | | | | | | | | | | | |
| 0060I | | | | | | | | | | | | | | | | | X | | | | | | |
| 0060L | | | | | | | | | | | | | | | | X | | | | | | | |
| 0060M | | | | | | | | | | | | | | | X | | | | | | | | |
| 0060R | | | | | | | | | | | | | | | | | | | | | X | | |
| 0060S | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0068 | | | | | | | | | X | X | | | | | X | X | | | | X | X | | |
| 0088 | | | | | | | | | | | | | | | | | | | | X | | | |
| 0088B | | | | | | | | | | | | | | | X | | | | | | | | |
| 0112F | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0112G | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0112I | | | | | | | | | | | | | | | X | | | | | | | | |
| 0136B | | | | | | | | | | X | | | | | | | | | | | | | |
| 0136C | | | | | | | | | | X | | | | | | | | | | | | | |
| 0176C | | | | | | | | | | | | | | | | | X | | X | | | | |
| 0176D | | | | | | | | | | | | | | | | | X | | X | | | | |
| 0180 | | | | | | | | X | | | | | | | | | | | | | | | |
| 0212 | X | | | | | | | | | | | | | | | | | | | | | | |
| 0248A | X | | | | | | | | | | | | | | | | | | | | | | |
| 0248E | | | | | | | | | | | | | | | | | X | | | | | | |
| 0256A | | | | | | | | | | | | | | | X | | | | | | | | |
| 0256K | | | | | | | | | | | | | | X | | | | | | | | | |
| 0256N | | | | | | | | | | | | | | | | | | | | X | | | |
| 0264 | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0264A | | | | | | | | | | | | | | | | | | | | | X | | |
| 0264C | | | | | | | | | | | | | | | X | | | | | | | | |
| 0264D | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0280B | X | | | | | | | | | | | | | | | | | | | | | | |
| 0320 | X | | | | | | | | | | | | | | | | | | | | | | |
| 0380 | X | | | | | | | | | | | | | | | | | | | | | | |
| 0384A | X | | | | | | | | | | | | | | | | | | | | | | |
| 0396A | X | X | X | | | | | | | | | | | | | | | | | | | | |
| 0396C | X | | | | | | | | | | | | | | | | | | | | | | |
| 0396D | | | | | | | | | X | | X | | | | | X | | | | | | | |
| 0432B | | | | | | | | | | | | | | | | | | | | | X | | |
| 0432E | | | | | | | | | | | | | | | X | | X | | | | | | |
| 0432J | | | | | | | | | X | | | | | | | | | | | | | | |
| 0432L | | | | | | | | | | | | | | | | | X | | | | | | |

TABLE XII-1
LIST OF POTW DISCHARGERS
PAGE 2

| PLANT | COKEMAKING | SINTERING | IRONMAKING | B.O.F. STEELMAKING | O.H. STEELMAKING | E.A.F. STEELMAKING | VACUUM DEGASSING | CONTINUOUS CASTING | HOT FORMING-PRIMARY | HOT FORMING-SECTION | HOT FORMING-FLAT | HOT FORMING-PIPE & TUBE | SALT BATH DESCALING-OXIDIZING | SALT BATH DESCALING-REDUCING | SULFURIC ACID PICKLING | HYDROCHLORIC ACID PICKLING | COMBINATION ACID PICKLING | COLD ROLLING | COLD FORMING-PIPE & TUBE | ALKALINE CLEANING | HOT COATINGS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0440A | | | | | | | | | | X | | | X | | | | X | | | | | | |
| 0444 | | | | | | | | X | | | | | | | | | | | | | | | |
| 0448A | | | | | | | | | | | X | | | | | X | | | | X | X | | |
| 0460A | | | | | | | | X | | | | | | | | | | | | | | | |
| 0460B | | | | | | | | | | X | | | | | | | | | | | | | |
| 0460C | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0460F | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0460G | | | | | | | | | | | | | | | X | | | | | | X | | |
| 0460H | | | | | | | | | | | | | | | X | | | | | X | X | | |
| 0464B | X | | | | | | | | | | | | | | | | | | | | | | |
| 0464C | X | | | | | | | | | | | | | | | | | | | | | | |
| 0528 | | | | | | | | | | | | | X | | | | | | | X | | | |
| 0548B | | | | | | | | | | | | | | | X | | X | | | X | | | |
| 0580 | | | | | | | | | | | | | | | X | X | X | | | X | | | |
| 0580B | | | | | | | | | | | | | | | | X | | | | X | | | |
| 0580C | | | | | | | | | | | | | | | X | X | | | | | | | |
| 0580E | | | | | | | | | | | | | | | | X | | | | X | | | |
| 0580F | | | | | | | | | | | | | | | | X | | | | | | | |
| 0580G | | | | | | | | | | | | | | | | | X | | | X | X | | |
| 0584B | X | | | | | | | | | | | | | | | | | | | | | | |
| 0636 | | | | | | | | | | | | | | | X | | X | | | X | | | |
| 0640A | | | | | | | | | | X | | | | | | | | | | | | | |
| 0640B | | | | | | | | | | | | | | | | | X | | | | X | | |
| 0648 | | | | | | | | | | | | | | | | | X | X | | | X | | |
| 0656A | X | | | | | | | | | | | | | | | | | | | | | | |
| 0672B | | | | | | | | | X | | | | | | | | | | | | | | |
| 0684H | X | | X | X | | | | | X | X | | X | | | | | | | | | | | |
| 0684K | | | | | | | | | | | | | | | X | | X | | | | | | |
| 0684Z | | | | | | | | | | | | | | | | | | | | | X | | |
| 0696A | | | | | | | | X | | | | | | | | | | | | | | | |
| 0740A | | | | | | | | X | | | | | | | | | | | | | | | |
| 0760 | | | | | | | | | | | | | | | X | | | | | X | | | |
| 0776C | | | | | | | | | | | | | | | | | X | | | X | | | |
| 0776D | | | | | | | | | | | | | | | X | | | | | X | | | |
| 0776J | | | | | | | | | | | | | | | | | X | | | | | | |
| 0792A | | | | | | | | | | | | | | | | | X | | | | X | | |
| 0792C | | | | | | | | | | | | | | | X | | | | | | | | |
| 0810 | X | | | | | | | | | | | | | | | | | | | | | | |
| 0856F | | | | | | | | | | | | | | | X | | | | | | | | |
| 0860H | | | | X | | X | | X | X | X | X | | | | | | | | | | | | |
| 0884E | | | | | | | | | | | | | | | | | X | | X | | | | |
| 0936 | | | | | | | | | | | | | | | | | | | | | X | | |
| 0946A | X | | | | | | | | | X | | | | | | | | | | | | | |
| 0948B | | | | | | | | | | | | | | | X | | | | | | | | |
| 0948C | X | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL (90 Sites) | 18 | 1 | 2 | 2 | 0 | 1 | 0 | 7 | 6 | 9 | 3 | 1 | 2 | 1 | 29 | 9 | 18 | 3 | 3 | 16 | 20 | | |

## TABLE XII-2

## PRETREATMENT COST SUMMARY
## IRON AND STEEL INDUSTRY

| | Capital | | Annual | |
|---|---|---|---|---|
| Subcategory/Subdivision | In-place | Required | In-Place | Required |
| A. Cokemaking | | | | |
| 1. I&S - Plants | 28.21 | 7.52 | 7.04 | 1.12 |
| 2. Merchant - Plants | 2.66 | 7.41 | 0.56 | 1.45 |
| *Cokemaking Total | 30.87 | 14.93 | 7.60 | 2.57 |
| B. Sintering | 3.23 | 0.36 | 0.78 | 0.05 |
| C. Ironmaking | 13.21 | 0.65 | 2.26 | 0.18 |
| D. Steelmaking | | | | |
| 1. BOF: Semi-Wet | - | - | - | - |
| 2. BOF: Wet-SC | 3.06 | 0.00 | 0.82 | 0.00 |
| 3. BOF: Wet-OC | 5.73 | 0.00 | 1.30 | 0.00 |
| 4. Open Hearth | - | - | - | - |
| 5. EAF: Semi-Wet | - | - | - | - |
| 6. EAF: Wet | 2.90 | 0.00 | 0.55 | 0.00 |
| *Steelmaking Total | 11.69 | 0.00 | 2.67 | 0.00 |
| E. Vacuum Degassing | - | - | - | - |
| F. Continuous Casting | 9.01 | 0.34 | 1.34 | 0.05 |
| G. Hot Forming | | | | |
| 1. Primary C w/s | 3.93 | 0.43 | -1.08 | 0.05 |
| 2. Primary C wo/s | 5.64 | 0.00 | -0.29 | 0.00 |
| 3. Primary S w/s | - | - | - | - |
| 4. Primary S wo/s | 0.67 | 0.30 | -0.08 | 0.04 |
| 5. Section Carbon | 11.47 | 2.66 | 0.00 | 0.18 |
| 6. Section Spec | 0.05 | 0.00 | -0.01 | 0.00 |
| 7. Flat C HS&S | 3.39 | 0.00 | -0.33 | 0.00 |
| 8. Flat S HS&S | - | - | - | - |
| 9. Flat C Plate | 2.81 | 0.00 | 0.07 | 0.00 |
| 10. Flat S Plate | - | - | - | - |
| 11. Pipe & Tube-Carbon | 1.16 | 0.00 | 0.14 | 0.00 |
| 12. Pipe & Tube-Spec | - | - | - | - |
| *Hot Forming Total | 29.12 | 3.39 | -1.58 | 0.27 |

TABLE XII-2
PRETREATMENT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

| Subcategory/Subdivision | Capital | | Annual | |
|---|---|---|---|---|
| | In-place | Required | In-Place | Required |
| H. Salt Bath Descaling | | | | |
| 1. Oxidizing - B S/P | - | - | - | - |
| 2. Oxidizing - B R/W/B | 0.07 | 0.20 | 0.01 | 0.03 |
| 3. Oxidizing - B P/T | - | - | - | - |
| 4. Oxidizing - Cont | 0.09 | 0.72 | 0.01 | 0.11 |
| 5. Reducing - Batch | 0.04 | 0.08 | 0.01 | 0.01 |
| 6. Reducing - Cont | - | - | - | - |
| *Salt Bath Descaling Total | 0.20 | 1.00 | 0.03 | 0.15 |
| I. Acid Pickling | | | | |
| 1. Sulfuric-R/W/C-Neut | 3.05 | 3.82 | 1.05 | 1.16 |
| 2. Sulfuric-S/S/P-Neut | 1.11 | 1.44 | 0.80 | 0.79 |
| 3. Sulfuric-B/B/B-Neut | 0.53 | 1.18 | 0.23 | 0.42 |
| 4. Sulfuric-P/T/O-Neut | 1.42 | 0.64 | 0.41 | 0.20 |
| 5. Sulfuric-S/S/P Au | - | - | - | - |
| 6. Sulfuric-R/W/C Au | - | - | - | - |
| 7. Sulfuric-B/B/B Au | - | - | - | - |
| 8. Sulfuric-P/T Au | - | - | - | - |
| 9. Hydrochloric-R/W/C | 1.18 | 3.52 | 0.40 | 0.75 |
| 10. Hydrochloric-S/S/P | 1.74 | 0.02 | 1.59 | 0.01 |
| 11. Hydrochloric-P/T | 0.01 | 0.02 | 0.00 | 0.00 |
| 12. Hydrochloric-S/S/P Ar | - | - | - | - |
| 13. Combination-R/W/C | 1.28 | 1.93 | 0.39 | 0.48 |
| 14. Combination-B S/S/P | - | - | - | - |
| 15. Combination-C S/S/P | 0.02 | 0.33 | 0.00 | 0.12 |
| 16. Combination-B/B/B | 0.44 | 0.11 | 0.15 | 0.03 |
| 17. Combination-P/T | 0.25 | 0.85 | 0.07 | 0.21 |
| *Acid Pickling Total | 11.03 | 13.86 | 5.09 | 4.17 |
| J. Cold Forming | | | | |
| 1. CR-Recirc Single | 0.00 | 0.03 | 0.00 | 0.00 |
| 2. CR-Recirc Multi | 0.00 | 0.03 | 0.00 | 0.00 |
| 3. CR-Combination | - | - | - | - |
| 4. CR-DA Single | - | - | - | - |
| 5. CR-DA Multi | - | - | - | - |
| 6. CW Pipe&Tube Water | 0.09 | 0.00 | 0.01 | 0.00 |
| 7. CW Pipe&Tube Oil | - | - | - | - |
| *Cold Forming Total | 0.09 | 0.06 | 0.01 | 0.00 |

TABLE XII-2
PRETREATMENT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

| Subcategory/Subdivision | Capital In-place | Capital Required | Annual In-Place | Annual Required |
|---|---|---|---|---|
| K. Alkaline Cleaning | | | | |
| 1. Batch | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Continuous | 0.47 | 0.00 | 0.06 | 0.00 |
| *Alkaline Cleaning Total | 0.47 | 0.00 | 0.06 | 0.00 |
| L. Hot Coating | | | | |
| 1. Galv. SS wo/s | 0.27 | 0.75 | 0.04 | 0.10 |
| 2. Galv. SS w/s | 0.14 | 0.00 | 0.02 | 0.00 |
| 3. Galv. Wire wo/s | 0.92 | 0.37 | 0.13 | 0.05 |
| 4. Galv. Wire w/s | 1.24 | 0.70 | 0.18 | 0.11 |
| 5. Terne wo/s | 0.01 | 0.05 | 0.00 | 0.01 |
| 6. Terne w/s | - | - | - | - |
| 7. Other SS wo/s | - | - | - | - |
| 8. Other SS w/s | - | - | - | - |
| 9. Other Wire wo/s | 0.07 | 0.43 | 0.01 | 0.06 |
| 10. Other Wire w/s | - | - | - | - |
| *Hot Coating Total | 2.65 | 2.30 | 0.38 | 0.33 |
| Total | 111.57 | 36.89 | 18.64 | 7.77 |
| Confidential Plants | 2.14 | 4.02 | 0.70 | 0.85 |
| Costs for Components Installed Beyond PSES | 18.27 | 0.00 | 2.75 | 0.00 |
| Industry Total | 131.98 | 40.91 | 22.09 | 8.62 |

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NOTES: Costs in millions of 7/1/78 dollars.
Basis: Facilities in-place as of 7/1/81.

# VOLUME I

## SECTION XIII

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Ludlum Steel Corporation, Wheeling-Pittsburgh Steel Corporation, Republic Steel Corporation, Lukens Steel Company, Laclede Steel Company, Plymouth Tube Co., The Stanley Steel Division, Youngstown Sheet & Tube Co., McLouth Steel Corp., Carpenter Technology, Universal Cyclops, Joslyn Steel, Crucible Inc., Babcock & Wilcox Company, Washington Steel, and Jessop Steel.

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# SECTION XIV

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## VOLUME I

## APPENDIX A

## STATISTICAL METHODOLOGY AND DATA ANALYSIS

### Introduction

### Statistical Methodology

This section provides an overview of the statistical methodology used by the Agency to develop effluent limitations for the steel industry. The methodology consists essentially of determining long term average pollutant discharges expected from well designed and operated treatment systems, and multiplying these long term averages by variability factors designed to allow for random fluctuations in treatment system performance. The resulting products yield daily maximum and 30-day average concentrations for each pollutant. The daily maximum and 30-day average concentrations were then multipled by an appropriate conversion factor and the respective treatment system model effluent flow rate to determine mass limitations. A general description of the methods employed to derive long term averages, variability factors, and the resulting concentrations follows. The development of the model treatment system flow rates are presented in each subcategory report.

### Determination of Long Term Average

For each wastewater treatment facility, an average pollutant concentration was calculated from the daily observations. The median of the plant averages for a pollutant was then used as the long term average for the industry. The long term average was determined for each pollutant to be limited and used to obtain the corresponding limitations for that pollutant.

The long term average (LTA) is defined as the expected discharge concentration (in mg/l) of a pollutant from a well designed, maintained, and operated treatment system. The long-term average is not a limitation, but rather a design value which the treatment system should be designed to attain over the long term.

### Determination of Variability Factors

Fluctuations in the pollutant concentrations discharged occur at well designed and properly operated treatment systems. These fluctuations may reflect temporary imbalances in the treatment system caused by fluctuations in flow, raw waste load of a particular pollutant, chemical feed, mixing flows within tanks, or a variety of other factors.

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Allowance for the day-to-day variability in the concentration of a pollutant discharged from a well designed and operated treatment system is accounted for in the standards by the use of a "variability factor." Under certain assumptions discussed below, application of a variability factor allows the calculation of an upper bound for the concentration of a particular pollutant. On the average a specified percent of the randomly observed daily values from treatment systems discharging this pollutant at a known mean concentration would be expected to fall below this bound. The 99th percentile for the daily maximum value is a commonly used and accepted level in the steel and other industrial categories. Also, this percentile has been chosen to provide a balance between appropriate considerations of day-to-day variation in a properly operating plant and the necessity to insure that a plant is operating properly.

The derivation of the variability factor for plants with more than 10 but less than 100 observations is based upon the assumption that the daily pollutant concentrations follow a lognormal distribution. This assumption is supported by plots of the empirical distribution function of observed concentrations for various pollutants (Figures A-1 to A-4). The plots of these data on lognormal probability paper approximated straight lines as would be expected of data that is lognormally distributed. It is also assumed that monitoring at a given plant was conducted responsibly and in such a way that resulting measurements can be considered independent and amenable to standard statistical procedures. A final assumption is that treatment facilities and monitoring techniques had remained substantially constant throughout the monitoring period.

The daily maximum variability factor is estimated by the equation (derived in Appendix XII-A1 of the Development Document for Electroplating Pretreatment Standards, EPA 440/1-79/003, August, 1979),

$$\ln(VF) = Z(Sigma) - .5(Sigma)^2 \qquad (1)$$

where

VF is the variability factor

Z is 2.33, which is the 99th percentile for the standard normal distribution, and

Sigma is the standard deviation of the natural logarithm of the concentrations.

For plants with 100 or more observations for a pollutant, there are enough data to use nonparametric statistics to calculate the daily maximum variability factor. For these cases, the variability factor was calculated by dividing the empirical 99th percentile by the pollutant average. The empirical 99th percentile is that observation whose percentile is nearest 0.99.

The estimated single-day variability factor for each pollutant discharged from a well designed and operated plant was calculated in the following manner:

1. For each plant with 10 or more but less than 100 observations, Sigma was calculated according to the standard statistical formula[14] and was then substituted into Equation (1) to find the VF.

2. For those plants with over 100 observations, the VF was estimated directly by dividing the 99th percentile of the observed sample values by their average.

3. The median of the plant variability factors was then calculated for each pollutant.

The variability factor for the average of a random sample of 30 daily observations about the mean value of a pollutant discharged from a well designed and operated treatment system was obtained by use of the Central Limit Theorem. This theorem states that the average of a sufficiently large sample of independent and identically distributed observations from any of a large class of population distributions will be approximately normally distributed. This approximation improves as the size of the sample, n, increases. It is generally accepted that a sample size of 25 or 30 is sufficient for the normal distribution to adequately approximate the distribution of the sample average. For many populations, sample sizes as small as 10 to 15 are sufficient.

The 30-day average variability factor, VF*, allows the calculation of an upper bound for the concentration of a particular pollutant. Under the same assumptions stated above, it would be expected that 95 percent of the randomly observed 30-day average values from a treatment system discharging the pollutant at a known mean concentration will fall below this bound. Thus, a well operated plant would be expected, on the average, to incur approximately one violation of the 30-day average limitation during a 20 month period. The 95th percentile was chosen in a manner analogous to that explained previously in the discussion of the daily variability factor.

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[14] $[\Sigma(xi - x)^2/(n-1)]^{1/2}$

where

$\underline{x}i$ is the ln of observation i
$\bar{x}$ is the average of observations
n is the number of observations

The 30-day average variability factor was estimated by the following equation (based on the Central Limit Theorem and previous assumptions),

$$(VF^{*}) = 1.0 + Z\ (S^{*}/A) \qquad (2)$$

where

- $VF^{*}$ is the 30-day average variability factor;
- $Z$ is 1.64, which is the 95th percentile of the standard normal distribution;
- $S^{*}$ is the estimated standard deviation of the 30-day averages, obtained by dividing the estimated standard deviation of the daily pollutant concentrations by the square root of 30; and,
- $A$ is the average pollutant concentration.

In the case of biological treatment of cokemaking wastewaters, the Agency determined that the general assumption of statistical independence between successive observations, which is a basis of the general formula, is not valid. The other assumptions underlying the application of the Central Limits Theorem valid. An analysis of the data for the biological treatment system at Plant 0868A indicated that sample measurements made over a number of succesive days are not independent. As a result, the Agency modified its method for calculating the 30-day average concentrations to account for this correlation. It should be noted that the Agency did not find correlations of any significance between successive sample measurements made at physical-chemical treatment systems used to treat other steel industry wastewaters.

The application of the Central Limit Theorem to the effluent data from biological treatment of cokemaking wastewaters remains valid. Thus, the variability factors, VF*, for the 30-day average concentrations are calculated using equation (2) above. However, to account for the statistical dependence of the effluent data, the correlation (covariance) terms are included in the calculation of the standard deviation of the 30-day averages, S*, as shown in Table A-51.

The effect of the dependency of the effluent data is to increase the standard deviation, and, thus, increase the 30-day average concentrations. The 30-day average concentration bases for total suspended solids, ammonia-N and total cyanide for the BAT (biological) limitations and NSPS for the cokemaking subcategory were calculated on this basis. The phenols (4AAP) concentration was determined using the original method since the Agency determined that the dependency of the effluent data for phenols (4AAP) are not significant.

### Determination of Limitations

Daily maximum and 30-day average concentrations ($L$ and $L^*$, respectively) were calculated for each pollutant from the long term average (LTA), the daily variability factor (VF), and the 30-day average variability factor (VF*) for that polluant by the following equations:

$$L = VF \times LTA \qquad (3)$$
$$L^* = VF^* \times LTA \qquad (4)$$

The above concentrations were multiplied by the effluent flow (gal/ton) developed for each treatment subcategory and an appropriate conversion factor to obtain mass limitations and standards in units of kg/1,000 kg of product.

The daily maximum limitation calculated for each pollutant is a value which is not to be exceeded on any one day by a plant discharging that pollutant. The 30-day average maximum limitation is a value which is not to be exceeded by the average of up to 30 consecutive single-day observations for the regulated pollutant. Long term data analyses are presented in Tables A-2 through A-50.

### Analysis of Data From Filtration and Clarification Treatment Systems

The observations used to derive daily maximum and 30-day average concentrations include both long term data obtained from the D-DCPs and agency requests, and short term data obtained through sampling visits. Engineering judgment[15] was used to delete some data from the long term data sets analyzed. Generally those data deleted indicate possible upsets, lack of proper operation of treatment facilities, or bypasses. These values typically could be considered effluent violations under the NPDES permit system. The number of observations deleted for each pollutant is identified in Tables A-9 to A-50. Table A-1 presents a key to the long-term data summaries for all plants included in the analyses. A discussion of the analyses for filtration and for clarification treatment systems follows.

### Filtration Treatment System

Table A-2 presents average concentrations and variability factors for total suspended solids for those plants[16] with long term effluent data for filtration treatment systems. Detailed descriptive statistics for all relevant pollutants sampled at these plants are presented in

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[15] The Agency's justification for using engineering judgment to delete values from monitoring data sets was upheld in U.S. Steel Corp. v. Train, 556 F.2d 822 (7th Cir. 1977).

[16] Plant 920N was not included in this long term data analysis. Visits to this plant by EPA personnel have demonstrated that the treatment system was not properly operated.

Tables A-9 to A-18. The median of the long term averages is multiplied by the apporpriate median variability factor to obtain the daily maximum and 30-day average concentrations for TSS as presented in Table A-2. Table A-3 presents, in a similar manner, averages, variability factors and daily maximum and 30-day average concentations for oil and grease.

The average concentrations for five toxic metals (chromium, copper, lead, nickel and zinc) calculated from long and short term data are presented with the respective medians in Table A-4. Variability factors, presented in Table A-5, were calculated for those plants having long term toxic metals data. The median daily maximum variability factors for the metals range from 2.0 to 4.5 and the 30-day variability factor for all of the toxic metals is 1.2. These values are similar to those obtained for TSS and oil and grease, in which case the daily maximum variability factors are 3.9 and 4.2 for TSS, and oil and grease, respectively; and the 30-day average variability factor is 1.3 for both pollutants. Since these variability factors were calculated from a larger data base, the Agency decided to use the average of these to represent the variability of the toxic metals. Therefore, variability factors of 4.0 and 1.3 were used to obtain the daily maximum and 30-day average concentrations, respectively. The results are presented in Table A-5. The daily maximum and 30-day average concentrations were rounded up to 0.3 and 0.1 mg/l, respectively, for all toxic metals except zinc. For zinc the daily maximum and 30-day average concentrations were rounded to 0.45 and 0.15 mg/l, respectively. These values were used to calculate the toxic metals mass limitations for filtration systems, where applicable.

## Clarification/Sedimentation Treatment System

Tables A-6 and A-7 present the average concentrations of long term data, the variability factors and the calculations used to derive the daily maximum and 30-day average concentrations for TSS and oil and grease, respectively. The long term effluent data and the resultant concentrations apply to clarifacation/sedimentation wastewater treatment systems. Detailed descriptive statistics of these plants are presented in Tables A-18 to A-37 and A-50. For Plants 0112, 0684F, and 0684H, long term data were provided for several parallel treatment systems in one central treatment facility. In these situations the data from the clarifier providing the best treatment were used.

Screening and verification data were used to calculate the average concentrations for toxic metals removal by clarification treatment systems treating wastewaters from carbon steel operations. These average concentrations are presented in Table A-8. Variability factors of 3.0 and 1.2 were used to calculate the daily maximum and 30-day average concentrations (shown in Table A-8), respectively, for all the metals. The above variability factors were based upon:

1. the variability factors for TSS and oil and grease in Tables A-6 and A-7; and,

2. the variability factors[17] derived from toxic metals discharged from clarification treatment systems in the electroplating category.

The daily maximum and 30-day average concentrations were rounded to 0.3 and 0.1 mg/l, respectively for chromium, copper, and zinc, and 0.45 and 0.2 mg/l for nickel, and 0.30 and 0.15 mg/l for lead. These concentrations were used to establish the toxic metals mass limitations for all forming and finishing operations, with the exception of combination acid pickling and salt bath descaling operations.

For combination acid pickling and salt bath descaling operations, both of which process speciality steels, the Agency relied on long term effluent data from a clarification treatment facility located at Plant 0060B. This treatment facility treated wastewaters from both of these specialty steel operations. The descriptive statistical data are presented in Table A-34. The daily maximum and the 30-day average concentrations used to establish the mass effluent limitations for chromium are 1.0 mg/l and 0.4 mg/l, respectively; and for nickel 0.7 mg/l and 0.3 mg/l, respectively.

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[17] Daily maximum variability factors presented in the "Development Document for Electro- plating Pretreatment Standards"; are: Cu - 3.2, Cr - 3.9, Ni - 2.9, Zn - 3.0, Pb - 2.9.

## TABLE A-1

## KEY TO LONG-TERM DATA SUMMARIES IRON & STEEL INDUSTRY

| Table No. | Reference Code | Subcategory | Treatment |
|---|---|---|---|
| A-9 | 0112B-5A | Hot Forming | Filtration |
| A-10 | 0112C-011 | Hot Forming | Filtration |
| A-11 | 0112C-122 | Hot Forming | Filtration |
| A-12 | 0112C-334 | Hot Forming | Filtration |
| A-13 | 0112C-617 | Hot Forming | Filtration |
| A-14 | 0112I-5A | Pickling/Al. Cleaning | Filtration |
| A-15 | 0384A-3E | Cont. Casting | Filtration |
| A-16 | 0384A-4L | Cont. Casting | Filtration |
| A-17 | 0684H-EF | Pipe & Tube | Filtration |
| A-18 | 0684F-4I | Hot Forming | Lagoons/Filtration |
| A-19 | 0112-5B | Ironmaking | Polymer/Clarifier |
| A-20 | 0112A-5A | Sintering | Thickener |
| A-21 | 0112H-5A | Comb. Acid Pickling | Clarifier/Lagoons |
| A-22 | 0320-5A | Hot Forming | Lagoons |
| A-23 | 0384A-5E | Ironmaking | Thickener |
| A-24 | 0384A-5F | Steelmaking (BOF) | Thickener/Clarifier |
| A-25 | 0584A-5F | Hot Forming | Settling Basin |
| A-26 | 0584B-5F | Hot Forming | Lagoons |
| A-27 | 0684F-5B | Ironmaking | Clarifier |
| A-28 | 0684F-5E | Ironmaking | Clarifier |
| A-29 | 0684H-5C | Ironmaking | Clarifier |
| A-30 | 0856N-5B | Hot Forming | Settling Basin |
| A-31 | 0860B | Ironmaking | Clarifier |
| A-32 | 0920G-5A | Cold Rolling | Clarifier |
| A-33 | 0060B | Comb. Acid Pickling | Lime/Lagoons |
| A-34 | 0060B | Comb. Acid Pickling | Lime/Clarifier |
| A-35 | 0860B | Forming & Finishing | Chem. Addition/Clarifiers |
| A-36 | 0584E | Misc. Finishing Operations | Chem. Addition/Clarifiers |
| A-37 | 0856D | Forming & Finishing | Chem. Addition/Clarifiers |
| A-38 | 0860B | Ironmaking | A. Chlorination/Filtration |
| A-39 | 0012A-5F | Cokemaking | Single-Stage Biological |
| A-40 | 0060A | Cokemaking | Single-Stage Biological |
| A-41 | 0868A | Cokemaking | 2-Stage Biological |
| A-42 | 0684F | Cokemaking | Phys-Chem (Carbon Columns) |
| A-43 | 0684F | Cold Rolling | Gas Flotation |
| A-44 | 0060 | Sintering | Filtration (Pilot) |
| A-45 | 0060 | Sintering | Lime/Clarifier (Pilot) |
| A-46 | 0060 | Sintering | Lime/Clar/Filter (Pilot) |
| A-47 | 0612 | Steelmaking - EAF | Filter (Pilot) |
| A-48 | 0612 | Steelmaking - EAF | Hydroxide/Clarifier (Pilot) |
| A-49 | 0612 | Steelmaking - EAF | Lime/Filter (Pilot) |
| A-50 | 0948C | Misc. Finishing Operations | Chem. Addition/Clarifiers |

## TABLE A-2

## LONG-TERM DATA ANALYSIS
## FILTRATION SYSTEMS
## TOTAL SUSPENDED SOLIDS

| Plant | Number of Sample Points | Average (mg/l) | Variability Factors |  |
|---|---|---|---|---|
|  |  |  | Average | Maximum* |
| 0112C-334 | 415 | 2.3 | 1.4 | 6.8 |
| 0112I-5A | 59 | 3.6 | 1.5 | 8.9 |
| 0112C-617 | 399 | 4.8 | 1.3 | 5.4 |
| 0684H-EF | 40 | 6.0 | 1.3 | 5.3 |
| 0112C-011 | 580 | 8.9 | 1.3 | 3.5 |
| 0112B-5A | 87 | 10.6 | 1.1 | 2.3 |
| 0384A-4L | 289 | 10.8 | 1.3 | 3.0 |
| 0112C-122 | 496 | 13.3 | 1.3 | 4.0 |
| 0384A-3E | 305 | 17.4 | 1.2 | 2.5 |
| 0684F-4I | 78 | 22.2 | 1.2 | 3.7 |
| Median Values |  | 9.8 | 1.3 | 3.9 |

30-Day Average Concentration Basis = (9.8 mg/l) (1.3) = 12.7 mg/l

Daily Maximum Concentration Basis = (9.8 mg/l) (3.9) = 38.2 mg/l

---

Note: For the purposes of developing effluent limitations and standards, the following values were used for total suspended solids.

Average = 15 mg/l
Maximum = 40 mg/l

* For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

## TABLE A-3

## LONG-TERM DATA ANALYSIS
## FILTRATION SYSTEMS
## OIL AND GREASE

| Plant | Number of Sample Points | Average (mg/l) | Variability Factors Average | Variability Factors Maximum* |
|---|---|---|---|---|
| 0112B-5A | 87 | 1.1 | 1.1 | 2.9 |
| 0112C-334 | 727 | 1.3 | 1.4 | 5.3 |
| 0112C-617 | 647 | 1.3 | 1.4 | 4.5 |
| 0112C-122 | 684 | 2.0 | 1.3 | 5.3 |
| 0684H-EF | 27 | 3.4 | 1.4 | 3.8 |
| 0112C-011 | 690 | 6.7 | 1.3 | 5.1 |
| 0384A-4L | 290 | 6.7 | 1.2 | 3.4 |
| Median Values | | 2.0 | 1.3 | 4.5 |

30-Day Average Concentration Basis = (2.0 mg/l) (1.3) = 2.6 mg/l

Daily Maximum Concentration Basis = (2.0 mg/l) (4.5) = 9.0 mg/l

---

Note: A maximum value of 10 mg/l has been used to develop effluent limitations and standards for oil and grease.

* For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

## TABLE A-4

### DATA ANALYSIS
### FILTRATION SYSTEMS
### REGULATED METALLIC POLLUTANTS

| Plant | Number of Sample Points | Average (mg/l) |
|---|---|---|
| A. Chromium | | |
| 0112I-5A | 61 | 0.02 |
| 0684F-4I | 11 | 0.03 |
| 0684H | 3 | 0.03 |
| 0584E | 3 | 0.03 |
| 0496 | 3 | 0.03 |
| 0612 | 3 | 0.04 |
| MEDIAN | | 0.03 |
| B. Copper | | |
| 0584F | 3 | 0.015 |
| 0684F-4I | 11 | 0.02 |
| 0684H | 3 | 0.02 |
| 0612 | 3 | 0.03 |
| 0496 | 3 | 0.05 |
| 0112I-5A | 60 | 0.05 |
| 0868B | 3 | 0.25 |
| MEDIAN | | 0.03 |
| C. Lead | | |
| 0684F-4I | 11 | 0.03 |
| 0684H | 3 | 0.05 |
| 0496 | 3 | 0.05 |
| 0112I | 3 | 0.07 |
| 0612 | 3 | 0.18 |
| 0868B | 3 | 0.32 |
| MEDIAN | | 0.06 |

TABLE A-4
DATA ANALYSIS
FILTRATION SYSTEMS
REGULATED METALLIC POLLUTANTS
PAGE 2

| Plant | Number of Sample Points | Average (mg/l) |
|---|---|---|
| D. Nickel | | |
| 0684H | 3 | 0.02 |
| 0612 | 3 | 0.025 |
| 0496 | 3 | 0.04 |
| 0112I-5A | 27 | 0.07 |
| 0684F-4I | 11 | 0.09 |
| MEDIAN | | 0.04 |
| E. Zinc | | |
| 0684H | 3 | 0.02 |
| 0584E | 3 | 0.02 |
| 0496 | 3 | 0.02 |
| 0112I-5A | 58 | 0.10 |
| 0612 | 3 | 0.12 |
| 0684F | 45 | 0.39 |
| 0868B | 3 | 1.6 |
| MEDIAN | | 0.10 |

## TABLE A-5

## DERIVATION OF VARIABILITY FACTORS AND PROPOSED LIMITS
## FILTRATION SYSTEMS
## REGULATED METALLIC POLLUTANTS

### Derivation of Variability Factors

| Parameter | No. of Sample Points | Variability Factors Average | Variability Factors Maximum |
|---|---|---|---|
| A. Chromium | | | |
| 0112I-5A | 61 | 1.2 | 2.9 |
| 0684F-4I | 11 | 1.2 | 3.6 |
| MEDIAN | | 1.2 | 3.3 |
| B. Copper | | | |
| 0112I-5A | 60 | 1.2 | 5.1 |
| 0684F-4I | 11 | 1.1 | 2.7 |
| MEDIAN | | 1.2 | 3.9 |
| C. Lead | | | |
| 0684F-4I | 11 | 1.1 | 2.0 |
| D. Nickel | | | |
| 0112I-5A | 27 | 1.2 | 3.3 |
| 0684F-4I | 11 | 1.2 | 5.6 |
| MEDIAN | | 1.2 | 4.5 |
| E. Zinc | | | |
| 0112I-5A | 58 | 1.2 | 3.0 |
| 0684F-4I | 45 | 1.2 | 4.2 |
| MEDIAN | | 1.2 | 3.6 |

Note: Use for all regulated metals
Average Variability Factor = 1.3
Maximum Variability Factor = 4.0

## TABLE A-5
## DERIVATION OF VARIABILITY FACTORS AND PROPOSED LIMITS
## FILTRATION SYSTEMS
## REGULATED METALLIC POLLUTANTS
## PAGE 2

### Derivation of Concentration Values

A. Chromium

30-Day Average Concentration Basis = (0.03)(1.3) = 0.04
Daily Maximum Concentration Basis = (0.03)(4.0) = 0.12

B. Copper

30-Day Average Concentration Basis = (0.03)(1.3) = 0.04
Daily Maximum Concentration Basis = (0.03)(4.0) = 0.12

C. Lead

30-Day Average Concentration Basis = (0.06)(1.3) = 0.08
Daily Maximum Concentration Basis = (0.06)(4.0) = 0.24

D Nickel

30-Day Average Concentration Basis = (0.04)(1.3) = 0.05
Daily Maximum Concentration Basis = (0.04)(4.0) = 0.16

E. Zinc

30-Day Average Concentration Basis = (0.10)(1.3) = 0.13
Daily Maximum Concentration Basis = (0.10)(4.0) = 0.40

---

Note: For the purposes of developing effluent limitations and standards, the following values were used for all metals except zinc:

Average = 0.10 mg/l
Maximum = 0.30 mg/l

For zinc, the following values have been used:

Average = 0.15 mg/l
Maximum = 0.45 mg/l

All concentration values are in mg/l.

## TABLE A-6

## LONG-TERM DATA ANALYSIS
## CLARIFICATION/SEDIMENTATION SYSTEMS
## TOTAL SUSPENDED SOLIDS

| Plant | Number of Sample Points | Average (mg/l) | Variability Factors | |
|---|---|---|---|---|
| | | | Average | Maximum* |
| 0584E | 853 | 5.2 | 1.1 | 2.3 |
| 0860B | 102 | 8.9 | 1.1 | 2.3 |
| 0112-5B | 291 | 9.9 | 1.3 | 4.0 |
| 0112H-5A | 49 | 11.7 | 1.2 | 3.2 |
| 0060B | 24 | 14.5 | 1.2 | 5.3 |
| 0320-5A | 151 | 15.8 | 1.2 | 2.3 |
| 0384A-5F | 97 | 16.1 | 1.1 | 2.8 |
| 0684H-5C | 74 | 19.0 | 1.2 | 5.4 |
| 0060B | 24 | 23.1 | 1.1 | 2.5 |
| 0684F-5B | 380 | 24.5 | 1.1 | 2.4 |
| 0584B-5F | 98 | 24.6 | 1.1 | 2.3 |
| 0920G-5A | 195 | 25.0 | 1.2 | 3.1 |
| 0584A-5F | 101 | 25.4 | 1.1 | 1.8 |
| 0384A-5E | 383 | 26.7 | 1.2 | 2.5 |
| 0856N-5B | 101 | 32.1 | 1.2 | 3.2 |
| 0856D | 17 | 33.1 | 1.2 | 3.4 |
| 0112A-5A | 175 | 35.7 | 1.2 | 2.5 |
| 0684F-5E | 528 | 45.5 | 1.0 | 3.6 |
| Median Values | | 23.8 | 1.2 | 2.7 |

30-Day Average Concentration Basis = (23.8 mg/l) (1.2) = 28.6 mg/l

Daily Maximum Concentration Basis = (23.8 mg/l) (2.7) = 64.3 mg/l

---

Note: For the purposes of developing effluent limitations and standards, the following values were used for total suspended solids:

Average = 30 mg/l
Maximum = 70 mg/l

*: For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

## TABLE A-7

## CLARIFICATION/OIL SKIMMING SYSTEMS OIL AND GREASE

| Plant | Number of Sample Points | Average (mg/l) | Variability Factors Average | Variability Factors Maximum* |
|---|---|---|---|---|
| 0320-5A | 35 | 0.1 | 1.2 | 4.0 |
| 0584E | 853 | 1.6 | 1.2 | 3.7 |
| 0684F-5E | 5 | 2.8 | 1.1 | 2.3 |
| 0856D | 17 | 4.0 | 1.1 | 1.7 |
| 0860B | 260 | 4.8 | 1.1 | 3.3 |
| 0584A-5F | 98 | 5.9 | 1.2 | 6.7 |
| 0856N-5B | 103 | 7.0 | 1.1 | 2.0 |
| 0584B-5F | 58 | 8.4 | 1.2 | 2.9 |
| MEDIAN VALUES | | 4.4 | 1.2 | 3.1 |

30-Day Average Concentration Basis = (4.4 mg/l)(1.2) = 5.3 mg/l
Daily Maximum Concentration Basis = (4.4 mg/l)(3.1) = 13.6 mg/l

---

Note: For the purposes of developing effluent limitations and standards, the following values were used for oil and grease:

Average = 10 mg/l
Maximum = 30 mg/l

* For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

TABLE A-8

## DATA ANALYSIS
## CLARIFICATION/SEDIMENTATION SYSTEMS
## REGULATED METALLIC POLLUTANTS

| Plant | Subcategory | Number of Sample Points | Average (mg/l) |
|---|---|---|---|
| A. Chromium | | | |
| 0856D | Forming & Finishing Wastes | 17 | 0.02 |
| 0948C | Pickling | 3 | 0.02 |
| NN-2 | Galvanizing | 3 | 0.03 |
| 0476A | Pickling | 3 | 0.03 |
| 0528 | Pickling | 3 | 0.03 |
| 0584E | Finishing Wastes | 853 | 0.04 |
| 0948C | Finishing Wastes | 236 | 0.04 |
| 0396A | Pickling | 3 | 0.08 |
| 0920E | Galvanizing | 3 | 0.27 |
| 0424-01 | Pickling | 3 | 1.32 |
| MEDIAN | | | 0.04 |

30-Day Average Concentration Basis = (0.04 mg/l)(1.2) = 0.05 mg/l
Daily Maximum Concentration Basis = (0.04 mg/l)(3.0) = 0.12 mg/l

| Plant | Subcategory | Number of Sample Points | Average (mg/l) |
|---|---|---|---|
| B. Copper | | | |
| 0948C | Pickling | 3 | 0.02 |
| 0476A | Pickling | 3 | 0.03 |
| 0528 | Pickling | 3 | 0.03 |
| 0920E | Galvanizing | 3 | 0.04 |
| 0424-01 | Pickling | 3 | 0.08 |
| 0396A | Pickling | 3 | 0.17 |
| MEDIAN | | | 0.04 |

30-Day Average Concentration Basis = (0.04 mg/l)(1.2) = 0.05 mg/l
Daily Maximum Concentration Basis = (0.04 mg/l)(3.0) = 0.12 mg/l

| Plant | Subcategory | Number of Sample Points | Average (mg/l) |
|---|---|---|---|
| C. Lead | | | |
| 0856D | Forming & Finishing Wastes | 17 | 0.02 |
| 0948C | Pickling | 3 | 0.05 |
| 0476A | Pickling | 3 | 0.10 |
| 0528 | Pickling | 3 | 0.10 |
| 0396A | Pickling | 3 | 0.57 |
| 0920E | Galvanizing | 3 | 0.60 |
| MEDIAN | | | 0.10 |

30-Day Average Concentration Basis = (0.10 mg/l)(1.2) = 0.12 mg/l
Daily Maximum Concentration Basis = (0.10 mg/l)(3.0) = 0.30 mg/l

TABLE A-8
DATA ANALYSIS
CLARIFICATION/SEDIMENTATION SYSTEMS
REGULATED METALLIC POLLUTANTS
PAGE 2

| Plant | Subcategory | Number of Sample Points | Average mg/l |
|---|---|---|---|
| D. Nickel | | | |
| 0948C | Pickling | 3 | 0.03 |
| 0476A | Pickling | 3 | 0.03 |
| 0528 | Pickling | 3 | 0.03 |
| 0396A | Pickling | 3 | 0.27 |
| 0424-01 | Pickling | 3 | 2.50 |
| 0920E | Galvanizing | 3 | 2.90 |
| MEDIAN | | | 0.15 |

30-Day Average Concentration Basis = (0.15 mg/l)(1.2) = 0.18 mg/l
Daily Maximum Concentration Basis = (0.15 mg/l)(3.0) = 0.45 mg/l

| Plant | Subcategory | Number of Sample Points | Average mg/l |
|---|---|---|---|
| E. Zinc | | | |
| 0528 | Pickling | 3 | 0.02 |
| 0424-01 | Pickling | 3 | 0.035 |
| 0584E | Finishing Wastes | 853 | 0.04 |
| 0476A | Pickling | 3 | 0.05 |
| 0948C | Finishing Wastes | 236 | 0.05 |
| 0948C | Pickling | 3 | 0.07 |
| 0856D | Forming & Finishing Wastes | 17 | 0.13 |
| 0396A | Pickling | 3 | 0.24 |
| 0920E | Galvanizing | 3 | 6.7 |
| MEDIAN | | | 0.05 |

30-Day Average Concentration Basis = (0.05 mg/l)(1.2) = 0.06 mg/l
Daily Maximum Concentration Basis = (0.05 mg/l)(3.0) = 0.15 mg/l

---

Note: For the purposes of developing effluent limitations and standards, the following values were used:

For chromium, copper and zinc:

Average = 0.10 mg/l
Maximum = 0.30 mg/l

For nickel:

Average = 0.20 mg/l
Maximum = 0.60 mg/l

For lead:

Average = 0.15 mg/l
Maximum = 0.45 mg/l

# TABLE A-9

## LONG-TERM DATA ANALYSIS

Plant : 0112B-5A
Subcategory: Hot Forming
Treatment : Filtration

| | Daily Maximum Analysis | | | | | | Monthly Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 87 | 1.6 | 24.4 | 10.6 | 3.9 | 2.3 | 0.7 | 1.1 |
| Oil & Grease | 87 | 0.2 | 3.8 | 1.1 | 0.6 | 2.9 | 0.1 | 1.1 |

---

$S_m$ : Monthly standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : Monthly variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-10

## LONG-TERM DATA ANALYSIS

Plant : 0112C-011
Subcategory: Hot Forming
Treatment : Filtration

| Pollutant | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 580(2) | 0.1 | 44.0 | 8.9 | 7.0 | 3.5 | 1.3 | 1.3 |
| Oil & Grease | 690(1) | 0.1 | 47.1 | 6.7 | 6.5 | 5.1 | 1.2 | 1.3 |

---

(1) 5 observations deleted
(2) 11 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-11

## LONG-TERM DATA ANALYSIS

Plant : 0112C-122
Subcategory: Hot Forming
Treatment : Filtration

| Pollutant | Daily Maximum Analysis |  |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
|  | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 496(2) | 0.1 | 63.4 | 13.3 | 12.4 | 4.0 | 2.3 | 1.3 |
| Oil & Grease | 684(1) | 0.1 | 20.3 | 2.0 | 2.2 | 5.3 | 0.4 | 1.3 |

---

(1) 1 observation deleted
(2) 7 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-12

## LONG-TERM DATA ANALYSIS

Plant : 0112C-334
Subcategory: Hot Forming
Treatment : Filtration

| Pollutant | Daily Maximum Analysis |  |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
|  | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 415 | 0.1 | 23.5 | 2.3 | 3.0 | 6.8 | 0.5 | 1.4 |
| Oil & Grease | 727 | 0.1 | 12.2 | 1.3 | 1.4 | 5.3 | 0.3 | 1.4 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor
* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-13

## LONG-TERM DATA ANALYSIS

Plant : 0112C-617
Subcategory: Hot Forming
Treatment : Filtration

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 399 | 0.1 | 33.8 | 4.8 | 5.5 | 5.4 | 1.0 | 1.3 |
| Oil & Grease | 647 | 0.1 | 7.9 | 1.3 | 1.3 | 4.5 | 0.3 | 1.4 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

# TABLE A-14

## LONG-TERM DATA ANALYSIS

Plant : 01121-5A
Subcategory: Pickling/Alkaline Cleaning
Treatment : Filtration

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 59(2) | 0.1 | 30.0 | 3.6 | 6.4 | 8.9 | 1.2 | 1.5 |
| Iron | 60(1) | 0.1 | 0.9 | 0.4 | 0.2 | 2.6 | 0.04 | 1.2 |
| Chromium | 61 | 0.01 | 0.06 | 0.02 | 0.01 | 2.9 | 0.002 | 1.2 |
| Copper | 60(1) | 0.01 | 0.2 | 0.05 | 0.04 | 5.1 | 0.007 | 1.2 |
| Zinc | 58(3) | 0.03 | 0.3 | 0.1 | 0.06 | 3.0 | 0.01 | 1.2 |
| Nickel | 27 | 0.02 | 0.2 | 0.07 | 0.04 | 3.3 | 0.007 | 1.2 |
| Aluminum | 27 | 0.2 | 0.4 | 0.2 | 0.03 | 1.3 | 0.006 | 1.0 |
| Phenol | 15 | 0.0005 | 0.01 | 0.006 | 0.003 | 4.2 | 0.0005 | 1.1 |

---

(1) 1 observation deleted
(2) 2 observations deleted
(3) 3 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$ : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-15

## LONG-TERM DATA ANALYSIS

Plant : 0384A-3E
Subcategory: Continuous Casting
Treatment : Filtration

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 305$^{(1)}$ | 1.0 | 45.0 | 17.4 | 9.3 | 2.5 | 1.7 | 1.2 |

---

(1) 3 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-16

## LONG-TERM DATA ANALYSIS

Plant : 0384A-4L
Subcategory: Continuous Casting
Treatment : Filtration

| Pollutant | Daily Maximum Analysis |  |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
|  | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 273(2) | 1.0 | 33.0 | 10.8 | 7.0 | 3.0 | 1.3 | 1.3 |
| Oil & Grease | 275(1) | 0.1 | 28.0 | 6.7 | 6.0 | 3.4 | 1.1 | 1.2 |

---

(1) 18 observations deleted
(2) 19 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-17

## LONG-TERM DATA ANALYSIS

Plant : 0684H-EF
Subcategory: Pipe & Tube
Treatment : Deep Bed Filter

| Pollutant | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 40(1) | 1.0 | 21.0 | 6.0 | 5.5 | 5.3 | 1.0 | 1.3 |
| Oil & Grease | 27 | 1.0 | 20.0 | 3.4 | 4.0 | 3.8 | 0.7 | 1.4 |

---

(1) 1 observation deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-18

## LONG-TERM DATA ANALYSIS

Plant : 0684F-41
Subcategory: Hot Forming
Treatment : Lagoon & Filtration

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **No. of Obs** | **Min** | **Max** | **Ave** | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 78 | 4.0 | 60.0 | 22.2 | 13.7 | 3.7 | 2.5 | 1.2 |
| Oil & Grease | 79(1) | 4.0 | 27.0 | 9.6 | 4.3 | 2.3 | 0.8 | 1.1 |
| Ammonia | 6(2) | 0.1 | 0.5 | 0.3 | 0.2 | 4.2 | 0.04 | 1.2 |
| Cyanide (Total) | 6 | 0.01 | 0.05 | 0.02 | 0.01 | 3.6 | 0.002 | 1.2 |
| Zinc | 45(3) | 0.03 | 1.0 | 0.39 | 0.23 | 4.2 | 0.2 | 1.2 |
| Chromium | 11 | 0.01 | 0.09 | 0.03 | 0.02 | 3.6 | 0.004 | 1.2 |
| Copper | 11 | 0.01 | 0.05 | 0.02 | 0.01 | 2.7 | 0.002 | 1.1 |
| Nickel | 11 | 0.01 | 0.2 | 0.09 | 0.07 | 5.6 | 0.01 | 1.2 |

TABLE A-18
LONG-TERM DATA ANALYSIS
PAGE 2

Plant : 0684F-4I
Subcategory: Hot Forming
Treatment : Lagoon & Filtration

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| Phenol | 6 | 0.01 | 0.4 | 0.1 | 0.1 | 9.0 | 0.02 | 1.3 |
| Cadmium | 11 | 0.001 | 0.009 | 0.004 | 0.002 | 3.4 | 0.0004 | 1.2 |
| Iron | 9 | 1.6 | 10.3 | 5.4 | 3.3 | 3.9 | 0.6 | 1.2 |
| Zinc (Diss.) | 74(3) | 0.02 | 3.4 | 0.5 | 0.7 | 7.2 | 0.6 | 1.2 |
| Lead | 11 | 0.02 | 0.06 | 0.03 | 0.01 | 2.0 | 0.002 | 1.1 |

---

(1) 1 observation deleted
(2) 2 observations deleted
(3) 24 observations deleted**

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$ : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

** : These observations were deleted since the hot forming wastewater treatment system was contaminated with the filtrate from sludges removed from a cold rolling, pickling and galvanizing central treatment system. This filtrate contains high zinc concentrations and resulted in NPDES permit violations for the hot forming discharge.

## TABLE A-19

## LONG-TERM DATA ANALYSIS

Plant : 0112-5B
Subcategory: Ironmaking
Treatment : Polymer/Clarifier

| Pollutant | No. of Obs | Daily Maximum Analysis |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
|  |  | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 291(1) | 1.0 | 92.4 | 9.9 | 9.2 | 4.0 | 1.7 | 1.3 |

---

(1) 7 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-20

## LONG-TERM DATA ANALYSIS

Plant : 0112A-5A
Subcategory: Sintering
Treatment : Thickener

| | | Daily Maximum Analysis | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | $175^{(2)}$ | 10.0 | 104.0 | 35.7 | 19.7 | 2.5 | 3.6 | 1.2 |
| Ammonia | 180 | 18.0 | 60.0 | 34.9 | 6.9 | 1.6 | 1.3 | 1.1 |
| Cyanide (Total) | 180 | 0.005 | 0.4 | 0.1 | 0.08 | 3.6 | 0.1 | 2.6 |
| Phenol | $178^{(1)}$ | 0.006 | 0.4 | 0.05 | 0.06 | 6.2 | 0.01 | 1.3 |

---

(1) 2 observations deleted
(2) 5 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-21

## LONG-TERM DATA ANALYSIS

Plant : 0112H-5A
Subcategory: Combination Acid Pickling
Treatment : Clarifier/Lagoon

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 49 | 2.8 | 25.6 | 11.7 | 5.9 | 3.2 | 1.1 | 1.2 |
| Iron | $47^{(2)}$ | 0.01 | 1.4 | 0.1 | 0.2 | 7.3 | 0.04 | 1.8 |
| Zinc | $49^{(1)}$ | 0.01 | 1.3 | 0.2 | 0.2 | 11.4 | 0.04 | 1.3 |

---

(1) 1 observation deleted
(2) 2 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-22

## LONG-TERM DATA ANALYSIS

Plant : 0320-5A
Subcategory: Hot Forming
Treatment : Lagoons

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 151$^{(1)}$ | 0.1 | 39.0 | 15.8 | 7.4 | 2.3 | 1.4 | 1.2 |
| Oil & Grease | 35 | 0.03 | 0.3 | 0.1 | 0.06 | 4.0 | 0.01 | 1.2 |
| Ammonia | 146 | 0.1 | 14.0 | 3.3 | 2.2 | 2.7 | 0.4 | 1.2 |

---

(1) 2 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-23

## LONG-TERM DATA ANALYSIS

Plant : 0384A-5E
Subcategory: Ironmaking
Treatment : Thickener

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 383(1) | 3.0 | 74.0 | 26.7 | 13.8 | 2.5 | 2.5 | 1.2 |

---

(1) 4 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

# TABLE A-24

## LONG-TERM DATA ANALYSIS

Plant : 0384A-5F
Subcategory: Steelmaking, Basic Oxygen Furnace
Treatment : Thickener/Clarifier

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 97 | 3.0 | 47.0 | 16.1 | 8.3 | 2.8 | 1.5 | 1.1 |
| Iron | 22 | 2.4 | 21.0 | 9.5 | 4.9 | 2.8 | 0.9 | 1.1 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-25

## LONG-TERM DATA ANALYSIS

Plant : 0584A-5F
Subcategory: Hot Forming
Treatment : Settling Basin

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 101$^{(1)}$ | 4.0 | 55.0 | 25.4 | 9.1 | 1.8 | 1.7 | 1.1 |
| Oil & Grease | 98 | 0.1 | 20.6 | 5.9 | 4.3 | 6.7 | 0.8 | 1.2 |

---

(1) 1 observation deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-26

## LONG-TERM DATA ANALYSIS

Plant : 0584B-5F
Subcategory: Hot Forming
Treatment : Lagoons

| Pollutant | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 98(1) | 10.0 | 50.0 | 24.6 | 8.6 | 2.3 | 1.6 | 1.1 |
| Oil & Grease | 58 | 2.0 | 29.0 | 8.4 | 4.2 | 2.9 | 0.8 | 1.2 |

---

(1) 3 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-27

## LONG-TERM DATA ANALYSIS

Plant : 0684F-5B
Subcategory: Ironmaking
Treatment : Clarifier

| Pollutant | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 380(1) | 6.0 | 64.0 | 24.5 | 11.2 | 2.4 | 2.0 | 1.1 |

---

(1) 1 observation deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor
* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

# TABLE A-28

## LONG-TERM DATA ANALYSIS

Plant : 0684F-5E
Subcategory: Ironmaking
Treatment : Clarifier

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 528(4) | 4.0 | 206.0 | 45.5 | 34.4 | 3.6 | 0.7 | 1.0 |
| Oil & Grease | 5 | 2.0 | 4.0 | 2.8 | 1.1 | 2.3 | 0.2 | 1.1 |
| Ammonia | 61(2) | 6.9 | 67.4 | 29.5 | 12.8 | 2.5 | 2.3 | 1.1 |
| Cyanide (Total) | 62(1) | 0.03 | 1.9 | 0.5 | 0.5 | 8.3 | 0.09 | 1.3 |
| Zinc | 5 | 0.1 | 0.4 | 0.2 | 0.1 | 3.6 | 0.02 | 1.2 |
| Chromium | 5 | 0.01 | 0.05 | 0.03 | 0.01 | 3.2 | 0.002 | 1.1 |
| Copper | 5 | 0.02 | 0.06 | 0.04 | 0.02 | 2.5 | 0.004 | 1.2 |
| Nickel | 5 | 0.03 | 0.08 | 0.06 | 0.02 | 2.1 | 0.004 | 1.1 |
| Phenol | 60(3) | 0.01 | 0.3 | 0.06 | 0.04 | 3.2 | 0.007 | 1.2 |

TABLE A-28
LONG-TERM DATA ANALYSIS
PAGE 2

Plant : 0684F-5E
Subcategory: Ironmaking
Treatment : Clarifier

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| Cadmium | 5 | 0.006 | 0.008 | 0.007 | 0.0009 | 1.3 | 0.0002 | 1.0 |
| Iron | 6 | 6.2 | 23.9 | 14.1 | 7.4 | 3.3 | 1.4 | 1.2 |
| Lead | 5 | 0.05 | 0.1 | 0.08 | 0.02 | 2.0 | 0.004 | 1.1 |

---

(1) 2 observations deleted
(2) 3 observations deleted
(3) 5 observations deleted
(4) 11 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-29

## LONG-TERM DATA ANALYSIS

Plant : 0684H-5C
Subcategory: Ironmaking
Treatment : Clarifier

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 74(2) | 1.0 | 64.0 | 19.0 | 15.4 | 5.4 | 2.8 | 1.2 |
| Ammonia | 73(3) | 0.1 | 36.0 | 13.4 | 8.0 | 5.1 | 1.5 | 1.2 |
| Cyanide (Total) | 75(1) | 0.02 | 6.98 | 0.8 | 1.5 | 9.8 | 0.3 | 1.6 |
| Phenol | 72(4) | 0.008 | 4.68 | 1.6 | 1.2 | 8.0 | 0.2 | 1.2 |
| Iron (Diss.) | 76 | 0.1 | 0.6 | 0.2 | 0.1 | 2.8 | 0.02 | 1.3 |

---

(1) 1 observation deleted
(2) 2 observations deleted
(3) 3 observations deleted
(4) 4 observations delted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-30

## LONG-TERM DATA ANALYSIS

Plant : 0856N-5B
Subcategory: Hot Forming
Treatment : Settling Basin

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 101(2) | 9.0 | 114.0 | 32.1 | 21.6 | 3.2 | 3.9 | 1.2 |
| Oil & Grease | 103(1) | 1.8 | 20.3 | 7.0 | 2.7 | 2.0 | 0.5 | 1.1 |
| Chromium | 43(1) | 0.005 | 0.2 | 0.06 | 0.05 | 7.4 | 0.009 | 1.2 |
| Zinc | 44 | 0.04 | 0.5 | 0.1 | 0.1 | 3.4 | 0.02 | 1.2 |

---

(1) 1 observation deleted
(2) 3 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-31

## LONG-TERM DATA ANALYSIS

Plant : 0860B
Subcategory: Ironmaking
Treatment : Clarifier

| Pollutant | Daily Maximum Analysis<br>No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | 30-Day Average Analysis<br>$S_m$ | $VF_m$ |
|---|---|---|---|---|---|---|---|---|
| TSS | 102 | 1.0 | 26.0 | 8.9 | 4.3 | 2.3 | 0.8 | 1.1 |
| Ammonia (N) | 102 | 4.7 | 98.1 | 53.1 | 15.4 | 1.7 | 2.8 | 1.1 |
| Cyanide (Total) | 102 | 0.01 | 6.2 | 1.9 | 1.6 | 3.3 | 0.3 | 1.3 |
| Phenol | 102 | 0.001 | 0.6 | 0.04 | 0.08 | 6.8 | 0.01 | 1.4 |
| Zinc | 18 | 0.1 | 0.7 | 0.4 | 0.2 | 4.0 | 0.04 | 1.2 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-32

## LONG-TERM DATA ANALYSIS

Plant : 0920G-5A
Subcategory: Cold Rolling
Treatment : Clarifier

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 195 | 2.0 | 81.0 | 25.0 | 13.3 | 3.1 | 2.4 | 1.2 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-33

## LONG-TERM DATA ANALYSIS

Plant : 0060B
Subcategory: Combination Acid Pickling
Treatment : Lime/Lagoons

|  |  | Daily Maximum Analysis |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 24 | 8.5 | 49.0 | 23.1 | 10.3 | 2.5 | 1.9 | 1.1 |
| Chromium | 21(1) | 0.02 | 0.59 | 0.14 | 0.15 | 5.4 | 0.03 | 1.4 |
| Nickel | 12(2) | 0.06 | 0.55 | 0.19 | 0.14 | 3.8 | 0.03 | 1.3 |

---

(1) 2 observations deleted
(2) 1 observation deleted

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-34

## LONG-TERM DATA ANALYSIS

Plant : 0060B
Subcategory: Combination Acid Pickling
Treatment : Lime/Clarifier

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 24 | 1.0 | 36.0 | 14.5 | 9.8 | 5.3 | 1.8 | 1.2 |
| Chromium | $22^{(1)}$ | 0.02 | 0.61 | 0.28 | 0.17 | 5.2 | 0.03 | 1.2 |
| Nickel | $19^{(2)}$ | 0.10 | 0.63 | 0.25 | 0.14 | 2.8 | 0.03 | 1.2 |

---

(1) 1 observation deleted
(2) 2 observations deleted

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-35

## LONG-TERM DATA ANALYSIS

Plant : 0860B
Subcategory: (1)
Treatment : Chemical Addition, Clarifiers

| Pollutant | No. of Obs | Daily Maximum Analysis<br>Min | Max | Ave | $S_d$ | $VF_d$* | 30-Day Average Analysis<br>$S_m$ | $VF_m$ |
|---|---|---|---|---|---|---|---|---|
| Oil & Grease | 260 | 1.0 | 18.0 | 4.8 | 2.4 | 3.3 | 0.43 | 1.1 |
| Chromium | 260 | 0.05 | 0.51 | 0.06 | 0.04 | 2.2 | 0.008 | 1.2 |
| Zinc | 260 | 0.05 | 0.30 | 0.06 | 0.02 | 2.5 | 0.005 | 1.1 |

---

(1) Treatment system receives wastes from numerous steel forming & finishing operations (pickling, cold rolling, alkaline cleaning, galvanizing, electroplating).

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-36

## LONG-TERM DATA ANALYSIS

Plant : 0584E
Subcategory: (1)
Treatment : Chemical Addition, Clarifiers

| Pollutant | Daily Maximum Analysis<br>No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | 30-Day Average Analysis<br>$S_m$ | $VF_m$ |
|---|---|---|---|---|---|---|---|---|
| TSS | 853 | 0.99 | 23.4 | 5.2 | 1.4 | 2.3 | 0.25 | 1.1 |
| Oil & Grease | 853 | ND | 15.8 | 1.6 | 1.2 | 3.7 | 0.22 | 1.2 |
| Cyanide | 853 | 0.09 | 0.29 | 0.10 | 0.015 | 1.6 | 0.003 | 1.0 |
| Chromium | 853 | 0.01 | 2.85 | 0.04 | 0.10 | 3.2 | 0.018 | 1.8 |
| Fluoride | 853 | 0.10 | 9.14 | 0.78 | 0.80 | 5.6 | 0.15 | 1.3 |
| Iron | 853 | ND | 8.0 | 0.63 | 0.46 | 3.5 | 0.08 | 1.2 |
| Zinc | 853 | 0.01 | 0.56 | 0.045 | 0.043 | 4.7 | 0.008 | 1.3 |

---

(1) Treatment system receives wastes from numerous steel finishing operations (pickling, cold rolling, alkaline cleaning, hot coating, galvanizing).

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-37

## LONG-TERM DATA ANALYSIS

Plant : 0856D
Subcategory: (1)
Treatment : Chemical Addition, Clarifiers

| Pollutant | | Daily Maximum Analysis | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 17 | 7.5 | 88.9 | 33.1 | 20.2 | 3.4 | 1.18 | 1.2 |
| Oil & Grease | 17 | 2.2 | 5.2 | 4.0 | 0.90 | 1.7 | 0.16 | 1.1 |
| Chromium | 17 | ND | 0.12 | 0.02 | 0.035 | 4.8 | 0.006 | 1.4 |
| Lead | 17 | ND | 0.14 | 0.018 | 0.032 | 3.6 | 0.006 | 1.5 |
| Zinc | 17 | ND | 0.45 | 0.13 | 0.13 | 10.5 | 0.024 | 1.3 |

---

(1) Treatment system receives wastes from numerous steel finishing operations (pickling, galvanizing, alkaline cleaning, electroplating)

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-38

## LONG-TERM DATA ANALYSIS

Plant : 0860B
Subcategory: Ironmaking
Treatment : Alkaline Chlorination/Filtration

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | $36^{(1)}$ | 0.5 | 18.0 | 3.6 | 4.0 | 7.1 | 0.7 | 1.3 |
| Oil & Grease | $39^{(2)}$ | 0.5 | 4.7 | 2.5 | 1.1 | 3.0 | 0.2 | 1.1 |
| Ammonia | $37^{(1)}$ | 0.1 | 16.5 | 4.5 | 4.0 | 7.0 | 0.7 | 1.3 |
| Cyanide | $36^{(3)}$ | 0.01 | 0.15 | 0.02 | 0.03 | 4.0 | 0.006 | 1.5 |
| Phenol | $38^{(1)}$ | 0.001 | 0.048 | 0.01 | 0.01 | 10.8 | 0.003 | 1.5 |
| Zinc | $6^{(2)}$ | 0.05 | 0.15 | 0.08 | 0.04 | 2.4 | 0.007 | 1.1 |

---

(1) 3 observations deleted
(2) 1 observation deleted
(3) 4 observations deleted

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$ : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-39

## LONG-TERM DATA ANALYSIS

Plant : 0012A-5F
Subcategory: By-product Cokemaking
Treatment : One-stage Biological

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 292(4) | 4.0 | 220.0 | 81.6 | 40.7 | 2.5 | 7.4 | 1.2 |
| Oil & Grease | 54 | 4.0 | 36.0 | 18.6 | 8.2 | 3.0 | 1.5 | 1.1 |
| Ammonia (N) | 298(2) | 14.0 | 224.0 | 61.7 | 41.6 | 3.4 | 7.6 | 1.2 |
| Cyanide (Total) | 173(1) | 0.5 | 6.8 | 2.6 | 1.4 | 2.5 | 0.3 | 1.2 |
| Phenol | 281(3) | 0.008 | 16.2 | 0.5 | 1.7 | 6.4 | 0.3 | 2.0 |

---

(1) 1 observation deleted
(2) 2 observations deleted
(3) 4 observations deleted
(4) 7 observations deleted

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

# TABLE A-40

## LONG-TERM DATA ANALYSIS

Plant : 0060A
Subcategory: By-product Cokemaking
Treatment : Single-Stage Biological Oxidation

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 632 | 1.00 | 5551.0 | 133.1 | 455.0 | 13.1 | 83.1 | 2.0 |
| Cyanide | 214 | 0.01 | 18.0 | 2.93 | 3.2 | 5.0 | 0.58 | 1.3 |
| Phenols (4AAP) | 298 | 0.001 | 0.13 | 0.006 | 0.009 | 4.3 | 0.002 | 1.5 |
| Ammonia | 635 | 0.20 | 200.0 | 21.9 | 36.5 | 7.7 | 6.7 | 1.5 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-41

## LONG-TERM DATA ANALYSIS

Plant : 0868A
Subcategory: By-Product Coke
Treatment : 2-stage Biological

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 1159(1) | 4 | 300 | 76 | 59 | 3.6 | 10.8 | 1.2 |
| Ammonia-(N) | 1303 | 0.07 | 124 | 7.0 | 16.8 | 7.5 | 3.1 | 1.7 |
| Cyanide (Total) | 1302 | 0.25 | 17.1 | 2.75 | 2.0 | 3.6 | 0.4 | 1.2 |
| Phenol | 1303 | 0.005 | 0.246 | 0.021 | 0.017 | 2.8 | 0.003 | 1.2 |
| Naphthalene, ppb | 21 | 10.0 | 10.0 | 10.0 | 0.0 | 1.0 | 0.0 | 1.0 |
| Benzo(a)pyrene, ppb | 20(2) | 10.0 | 52.0 | 13.4 | 10.7 | 2.6 | 2.0 | 1.2 |
| Benzene, ppb | 21 | 10.0 | 10.0 | 10.0 | 0.0 | 1.0 | 0.0 | 1.0 |

---

(1) 78 observations deleted
(2) 1 observation deleted

Note: All concentration values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$ : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-42

## LONG-TERM DATA ANALYSIS

Plant : 0684F
Subcategory: Cokemaking
Treatment : Phys-Chem (Carbon Columns)

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| Ammonia | 103 | 11.8 | 860.0 | 129.8 | 115.9 | 5.1 | 21.2 | 1.3 |
| Cyanide | 102 | 0.4 | 68.0 | 19.8 | 11.0 | 3.8 | 2.0 | 1.2 |
| Phenol | 102 | 0.001 | 0.8 | 0.04 | 0.1 | 14.0 | 0.02 | 1.9 |
| TSS | 104 | 3.0 | 146.0 | 25.6 | 20.5 | 4.5 | 3.7 | 1.2 |

---

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor
* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-43

## LONG-TERM DATA ANALYSIS

Plant : 0684F
Subcategory: Cold Rolling
Treatment : Gas Flotation

| Pollutant | Daily Maximum Analysis |  |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
|  | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 104(1) | 1.00 | 66.0 | 15.8 | 11.2 | 3.8 | 2.0 | 1.2 |
| Oil & Grease | 105 | 2.0 | 21.0 | 7.3 | 4.3 | 3.2 | 0.8 | 1.2 |
| Benzene | 17 | ND | 0.028 | 0.003 | 0.007 | 4.8 | 0.001 | 1.5 |
| Chloroform | 17 | ND | 0.018 | 0.002 | 0.004 | 4.0 | 0.001 | 1.8 |
| 1,2-trans-dichloroethylene | 1 | 0.13 | 0.13 | 0.13 | 0.00 | 1.0 | 0.00 | 1.0 |
| Methylene Chloride | 17 | ND | 0.042 | 0.008 | 0.014 | 10.3 | 0.003 | 1.6 |
| Trichlorofluoromethane | 5 | 0.023 | 0.16 | 0.059 | 0.06 | 4.7 | 0.01 | 1.3 |
| Isophorone | 1 | 0.004 | 0.004 | 0.004 | 0.00 | 1.0 | 0.00 | 1.0 |
| Naphthalene | 16 | ND | 0.092 | 0.012 | 0.028 | 11.8 | 0.005 | 1.7 |
| 2-Nitrophenol | 16 | ND | 0.013 | 0.002 | 0.003 | 3.6 | 0.001 | 1.8 |
| 4-Nitrophenol | 1 | 0.47 | 0.47 | 0.47 | 0.00 | 1.0 | 0.00 | 1.0 |
| Phenol | 16 | ND | 0.77 | 0.093 | 0.22 | 15.2 | 0.04 | 1.7 |
| Bis(2-ethylhexyl)phthalate | 16 | ND | 0.016 | 0.002 | 0.004 | 4.0 | 0.001 | 1.8 |

TABLE A-43
LONG-TERM DATA ANALYSIS
PAGE 2

Plant : 0684F
Subcategory: Cold Rolling
Treatment : Gas Flotation

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| Diethyl Phthalate | 16 | 0.024 | 0.27 | 0.18 | 0.06 | 3.2 | 0.011 | 1.1 |
| Dimethyl Phthalate | 14 | 0.05 | 0.11 | 0.07 | 0.03 | 3.1 | 0.005 | 1.1 |
| Tetrachloroethylene | 17 | ND | 0.15 | 0.035 | 0.05 | 14.9 | 0.009 | 1.4 |
| Toluene | 17 | ND | 0.032 | 0.004 | 0.008 | 6.8 | 0.001 | 1.4 |
| Trichloroethylene | 17 | ND | 0.010 | 0.002 | 0.002 | 3.2 | 0.00 | 1.0 |

---

(1) 1 observation deleted

Note: All concentration values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-44

## LONG-TERM DATA ANALYSIS

Plant : 0060
Subcategory: Sintering
Treatment : Filtration (Pilot)

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 11(1) | 1.00 | 7.0 | 3.1 | 1.7 | 3.0 | 0.3 | 1.2 |
| Oil & Grease | 6 | 5.0 | 9.0 | 5.7 | 1.6 | 1.7 | 0.3 | 1.1 |
| Cyanide | 12 | 0.03 | 0.26 | 0.13 | 0.07 | 3.4 | 0.01 | 1.1 |
| Phenol | 12 | 0.01 | 0.22 | 0.07 | 0.06 | 4.6 | 0.01 | 1.2 |
| Chromium | 12 | 0.01 | 0.43 | 0.17 | 0.17 | 10.0 | 0.03 | 1.3 |
| Copper | 12 | 0.02 | 0.03 | 0.02 | 0.00 | 1.2 | 0.00 | 1.0 |
| Nickel | 12 | 0.01 | 0.02 | 0.01 | 0.01 | 1.9 | 0.00 | 1.0 |
| Lead | 12 | 0.02 | 0.03 | 0.02 | 0.00 | 1.3 | 0.00 | 1.0 |
| Zinc | 12 | 0.02 | 0.47 | 0.18 | 0.15 | 5.8 | 0.03 | 1.3 |

---

(1) 1 observation deleted

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-45

## LONG-TERM DATA ANALYSIS

Plant : 0060
Subcategory: Sintering
Treatment : Lime/Clarifier (Pilot)

|  | Daily Maximum Analysis |  |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 12 | 4.0 | 92.0 | 47.4 | 26.3 | 5.0 | 4.8 | 1.2 |
| Oil & Grease | 8 | 1.0 | 5.0 | 2.9 | 1.5 | 3.5 | 0.3 | 1.2 |
| Fluoride | 12 | 12.0 | 43.0 | 18.4 | 8.8 | 2.2 | 1.6 | 1.1 |
| Cyanide | 12 | 0.02 | 0.11 | 0.07 | 0.03 | 2.8 | 0.005 | 1.1 |
| Phenol | 12 | 0.10 | 0.43 | 0.2 | 0.1 | 2.6 | 0.02 | 1.2 |
| Chromium | 12 | 0.03 | 0.29 | 0.14 | 0.08 | 4.4 | 0.15 | 1.2 |
| Nickel | 12 | 0.01 | 0.03 | 0.01 | 0.008 | 2.4 | 0.001 | 1.3 |
| Lead | 12 | 0.02 | 0.18 | 0.03 | 0.05 | 3.6 | 0.008 | 1.4 |
| Zinc | 12 | 0.02 | 0.08 | 0.04 | 0.02 | 2,5 | 0.003 | 1.1 |

---

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-46

## LONG-TERM DATA ANALYSIS

Plant : 0060
Subcategory: Sintering
Treatment : Lime/Clarifier/Filter (Pilot)

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 12 | 1.0 | 61.0 | 9.8 | 19.7 | 10.4 | 3.6 | 1.6 |
| Oil & Grease | 8 | 1.0 | 4.0 | 2.1 | 1.1 | 3.2 | 0.2 | 1.2 |
| Fluoride | 12 | 11.0 | 24.0 | 15.9 | 4.4 | 1.8 | 0.8 | 1.1 |
| Cyanide | 12 | 0.03 | 0.11 | 0.07 | 0.03 | 2.3 | 0.005 | 1.1 |
| Phenol | 12 | 0.03 | 0.30 | 0.15 | 0.09 | 3.9 | 0.02 | 1.2 |
| Chromium | 12 | 0.02 | 0.24 | 0.13 | 0.08 | 4.6 | 0.01 | 1.2 |

---

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-47

## LONG-TERM DATA ANALYSIS

Plant : 0612
Subcategory: Steelmaking - Electric Furnace
Treatment : Filter (Pilot)

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 11 | 4.0 | 16.0 | 9.5 | 4.7 | 3.1 | 0.9 | 1.2 |
| Cadmium | 11 | 0.05 | 6.0 | 1.9 | 1.6 | 8.7 | 0.30 | 1.3 |
| Chromium | 11 | 0.04 | 0.5 | 0.2 | 0.2 | 5.7 | 0.03 | 1.3 |
| Copper | 11 | 0.04 | 0.2 | 0.09 | 0.04 | 2.4 | 0.01 | 1.2 |
| Nickel | 11 | 0.05 | 0.5 | 0.2 | 0.2 | 5.4 | 0.03 | 1.3 |
| Lead | 11 | 0.10 | 2.6 | 1.0 | 0.7 | 6.6 | 0.14 | 1.2 |
| Zinc | 11 | 1.10 | 79.0 | 37.0 | 28.7 | 11.1 | 5.2 | 1.2 |

---

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-48

## LONG-TERM DATA ANALYSIS

Plant : 0612
Subcategory: Steelmaking - Electric Furnace
Treatment : Hydroxide/Clarifier (Pilot)

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 8 | 9.0 | 33.0 | 21.9 | 9.8 | 3.0 | 1.8 | 1.1 |
| Cadmium | 8 | 0.02 | 0.10 | 0.04 | 0.03 | 3.4 | 0.01 | 1.4 |
| Chromium | 8 | 0.07 | 2.8 | 1.04 | 0.9 | 9.0 | 0.17 | 1.3 |
| Copper | 8 | 0.01 | 0.03 | 0.03 | 0.01 | 2.3 | 0.00 | 1.0 |
| Nickel | 8 | 0.05 | 0.10 | 0.06 | 0.02 | 1.9 | 0.00 | 1.0 |
| Lead | 8 | 0.06 | 0.21 | 0.14 | 0.06 | 3.0 | 0.01 | 1.1 |
| Zinc | 8 | 0.23 | 0.75 | 0.40 | 0.17 | 2.3 | 0.03 | 1.1 |

---

Note: All values are in mg/l unless otherwise noted.

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$ : 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-49

## LONG-TERM DATA ANALYSIS

Plant : 0612
Subcategory: Steelmaking, Electric Furnace
Treatment : Lime Precipitation/Filtration (Pilot)

|  | Daily Maximum Analysis |  |  |  |  |  | 30-Day Average Analysis |  |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | $S_d$ | $VF_d$* | $S_m$ | $VF_m$ |
| TSS | 12 | 4.0 | 14.0 | 8.8 | 3.3 | 2.4 | 0.6 | 1.1 |
| Cadmium | 12 | 0.02 | 0.5 | 0.07 | 0.14 | 5.6 | 0.03 | 1.7 |
| Chromium | 12 | 0.05 | 2.9 | 0.9 | 0.9 | 11.0 | 0.16 | 1.3 |
| Copper | 12 | 0.01 | 0.5 | 0.08 | 0.15 | 8.7 | 0.03 | 1.6 |
| Nickel | 12 | 0.05 | 0.13 | 0.08 | 0.03 | 2.5 | 0.01 | 1.2 |
| Lead | 12 | 0.03 | 0.8 | 0.23 | 0.2 | 4.9 | 0.04 | 1.3 |
| Zinc | 12 | 0.1 | 0.66 | 0.28 | 0.15 | 2.7 | 0.03 | 1.2 |

---

$S_m$ : 30-Day standard deviation = $S_d/(30)^{.5}$
$S_d$ : Daily standard deviation
$VF_m$: 30-Day variability factor
$VF_d$: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-50

## LONG-TERM DATA ANALYSIS

Plant : 0948C
Subcategory: Misc. Finishing Operations(1)
Treatment : Chemical Addition and Clarification

| | Daily Maximum Analysis | | | | | | 30-Day Average Analysis | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | No. of Obs | Min | Max | Ave | Sd | VFd* | Sm | VFm |
| Cyanide | 237 | 0.010 | 0.21 | 0.056 | 0.029 | 2.8 | 0.005 | 1.15 |
| Chromium | 236(2) | 0.010 | 0.28 | 0.040 | 0.14 | 5.0 | 0.025 | 2.03 |
| Ammonia-N | 237 | 0.30 | 1.80 | 0.95 | 0.29 | 1.8 | 0.053 | 1.09 |
| Oil & Grease | 237 | 1.00 | 4.00 | 1.67 | 0.70 | 1.8 | 0.13 | 1.13 |
| Phenol | 237 | 0.0010 | 0.14 | 0.0080 | 0.009 | 2.5 | 0.002 | 1.41 |
| TSS | 237 | 1.00 | 41.00 | 8.84 | 6.19 | 3.2 | 1.13 | 1.21 |
| Zinc | 236(2) | 0.010 | 0.30 | 0.048 | 0.069 | 4.4 | 0.013 | 1.44 |

---

(1) Treatment system receives waste from numerous steel finishing operations (pickling, cold rolling, hot coating and tin mills).

(2) One observation deleted.

Sm : 30-day standard deviation = $Sd/(30)^{0.5}$
Sd : Daily standard deviation
VFm: 30-day variability factor
VFd: Daily variability factor
* : For plant with more than 100 observations: $VFd = \frac{\text{99th Percentile}}{\text{Average}}$

## TABLE A-51

## STANDARD DEVIATION OF THE 30-DAY AVERAGES

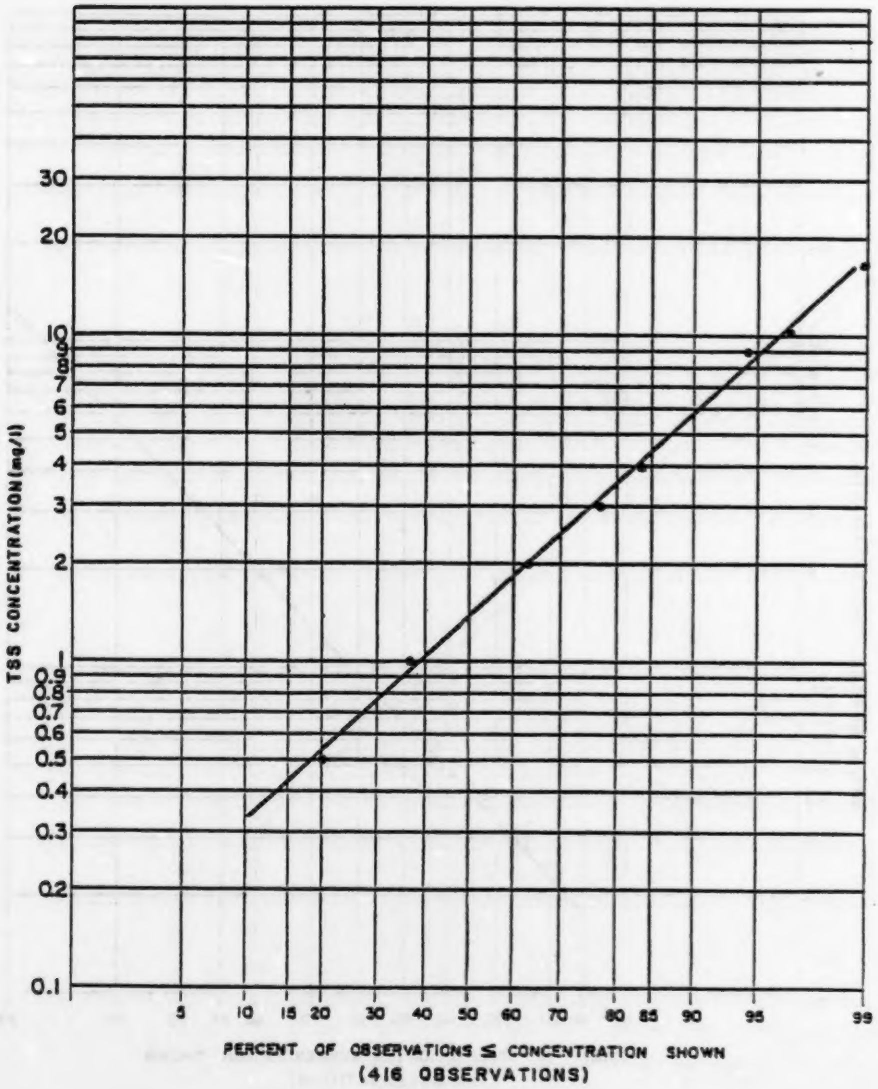
$$S^* = [\ \mathrm{Var}\ (\bar{X}_n)]^{1/2}$$

where, $$\mathrm{Var}\ (\bar{X}_n) = \frac{S^2}{n^2} \left[\ n + 2 \sum_{k=1}^{n-1} (n-k)\ r_k\ \right]$$

$$S^2 = \sum_{i=1}^{N} \frac{(X_i - \bar{x})^2}{N-1}$$

$$r_k = \frac{\displaystyle\sum_{j=1}^{N-k} (X_j - \bar{x})\ (X_j + k - \bar{x})\ /\ (N-k)}{\displaystyle\sum_{i=1}^{N} (X_i - \bar{x})^2\ /\ (N-1)}$$

## FIGURE A-1
## LOG-PROBABILITY PLOT
## PLANT 0112C-334
## FILTRATION



## FIGURE A-2
## LOG-PROBABILITY PLOT
## PLANT 0112C-334
## FILTRATION

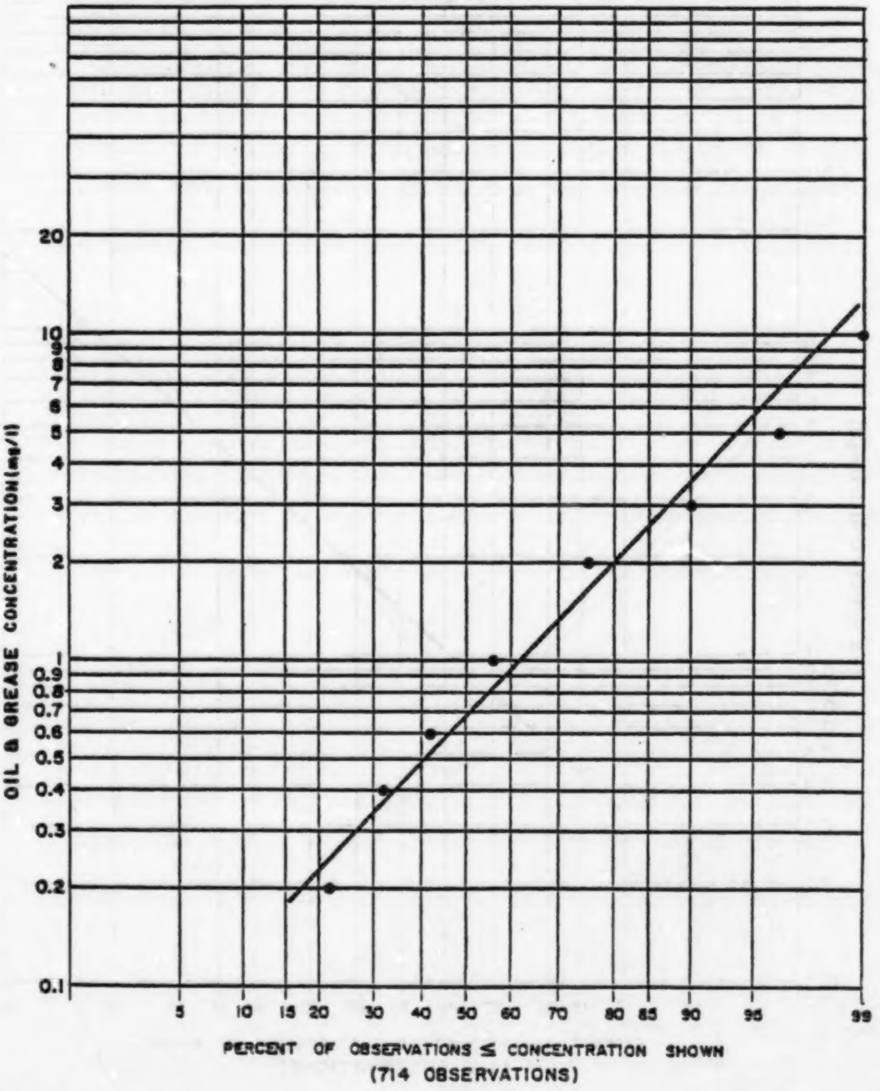
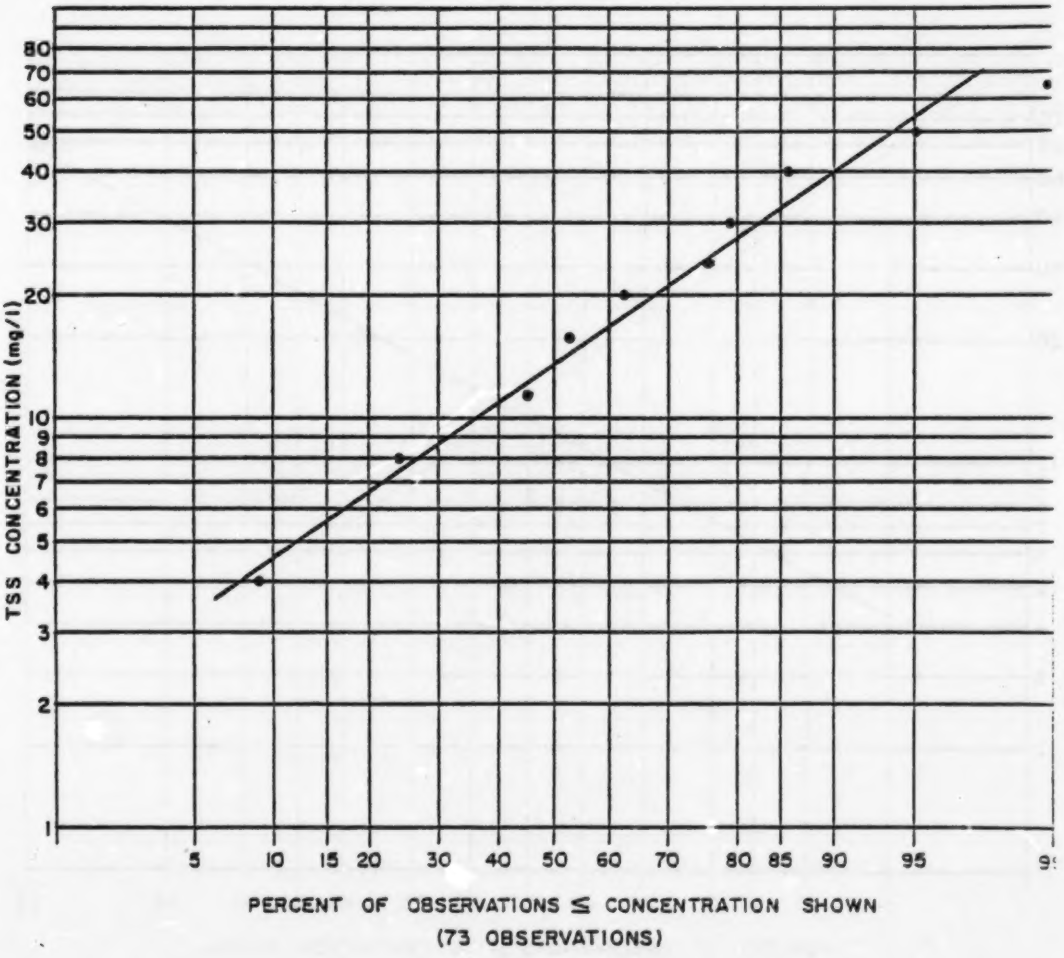
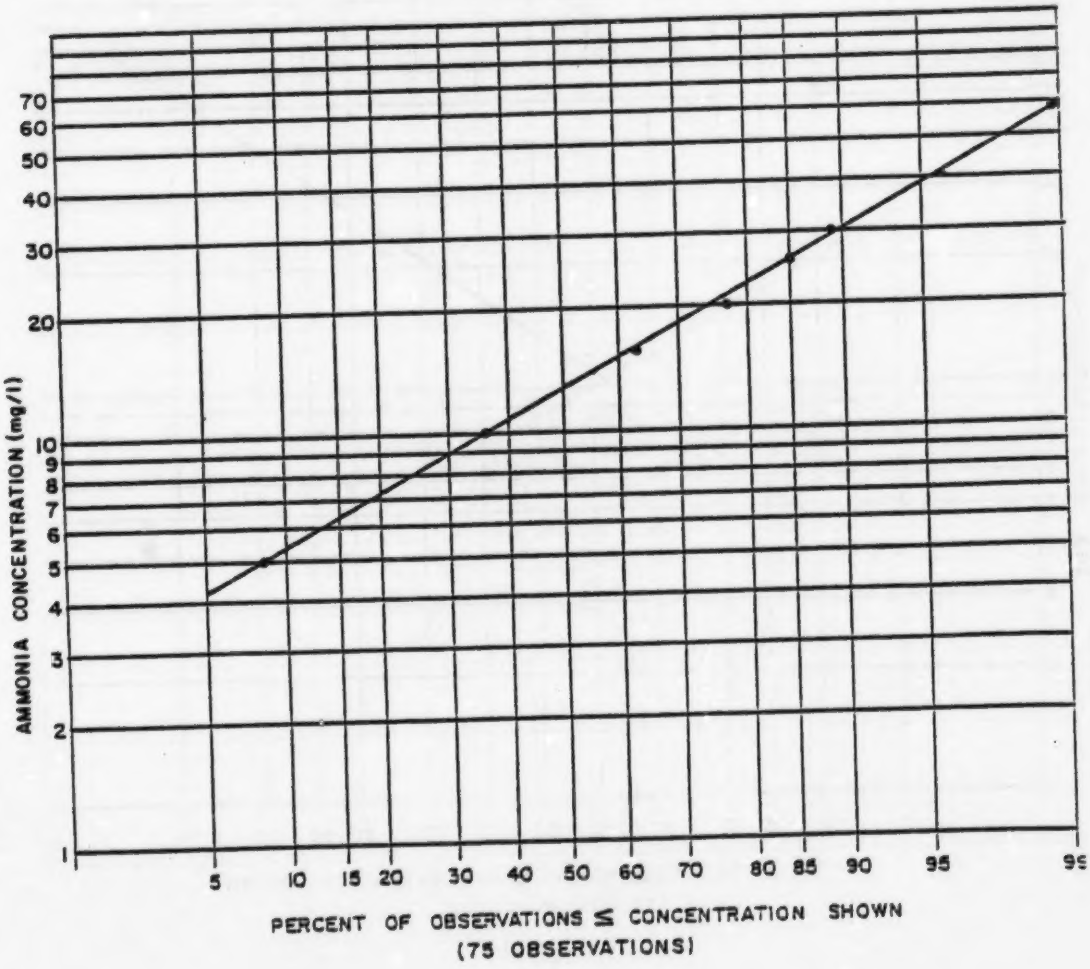


FIGURE A-3
LOG-PROBABILITY PLOT
PLANT 0684H-5C
CLARIFIER



# FIGURE A-4
# LOG-PROBABILITY PLOT
# PLANT 0684H-5C
# CLARIFIER



# VOLUME I

# APPENDIX B

# IRON AND STEEL PLANT INVENTORY

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0004 | | ACCO<br>BRIDGEPORT | CT | 06602 | | NO | |
| | A | PAGE FENCE DIVISION<br>MONESSEN | PA | 15062 | | NO | |
| | B | AMERICAN CHAIN DIVISION<br>YORK | PA | 17403 | | NO | |
| | C | CABLE CONTROLS DIVISION<br>ADRIAN | MI | 49221 | | NO | |
| 0008 | | ADCOM METALS COMPANY, INC.<br>JACKSONVILLE | FL | 32202 | | NO | |
| | A | ADCOM METALS COMPANY, INC.<br>NICHOLASVILLE | KY | 40356 | | NO | |
| | B | CONTAINER WIRE PRODUCTS COMPANY<br>JACKSONVILLE | FL | 32202 | | NO | |
| 0012 | | ALABAMA BY-PRODUCTS CORPORATION<br>BIRMINGHAM | AL | 35202 | | YES | |
| | A | TARRANT COKE PLANT<br>TARRANT | AL | 35217 | A | YES | |
| | B | KEYSTONE COKE<br>CONSHOHOCKEN | PA | 19428 | A | YES | FORMERLY 0016A |
| 0016 | | ALAN WOOD STEEL COMPANY<br>CONSHOHOCKEN | PA | 19428 | D1 | YES | |
| | A | | | | | | SEE 0012B |
| | B | ALAN WOOD STEEL COMPANY<br>IVY ROCK | PA | 19248 | | NO | |
| | C | ALAN WOOD COATED METALS<br>CORNWELLS HEIGHTS | PA | 19020 | | NO | |
| 0020 | | ALLEGHENY LUDLUM STEEL CORPORATION<br>PITTSBURGH | PA | 15222 | | YES | |
| | A | ALLEGHENY LUDLUM STEEL CORPORATION<br>PITTSBURGH | PA | 15222 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0020 | B | BRACKENRIDGE PLANT<br>BRACKENRIDGE | PA | 15014 | D1,D3,E,G1,G3,H,I1,I3,<br>J1 | YES | |
| | C | WEST LEECHBURG PLANT<br>LEECHBURG | PA | 15656 | I2,I3,J1 | YES | |
| | D | BAR PRODUCTS DIVISION<br>DUNKIRK | NY | 14048 | | NO | |
| | E | BAR PRODUCTS DIVISION<br>WATERVLIET | NY | 12189 | | NO | |
| | F | AJAX FORGING & CASTING COMPANY<br>FERNDALE | MI | 48220 | | NO | |
| | G | SPECIAL METALS CORPORATION<br>NEW HARTFORD | NY | 13413 | | NO | |
| | H | WALLINGFORD STEEL<br>WALLINGFORD | CT | 06492 | | NO | |
| | I | ARNOLD ENGINEERING COMPANY<br>MARENGO | IL | 60152 | D3 | YES | |
| | J | CARMET COMPANY<br>PITTSBURGH | PA | 15222 | | NO | |
| | K | ALJAX STEEL CORPORATION<br>BUFFALO | NY | 14207 | D3 | YES | |
| | L | NEW CASTLE PLANT<br>NEW CASTLE | IN | 47362 | I3,J1 | YES | |
| 0024 | | ALLIED CHEMICAL CORPORATION<br>MORRISTOWN | NJ | 07960 | | NO | |
| | A | ASHLAND COKE PLANT<br>ASHLAND | KY | 41101 | A | YES | |
| | B | DETROIT COKE PLANT<br>DETROIT | MI | 48231 | A | NO | |
| | C | | | | | | SEE 0402 |
| | D | | | | | | SEE 0810 |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0028 | ALLIED TUBE & CONDUIT CORPORATION<br>HARVEY | IL | 60426 | | NO | |
| 0032 | AMERICAN CAST IRON PIPE COMPANY<br>BIRMINGHAM | AL | 35202 | | YES | |
| A | ACIPCO STEEL PRODUCTS DIVISION<br>BIRMINGHAM | AL | 35207 | D3 | YES | |
| 0036 | AMERICAN COMPRESSED STEEL CORPORATION<br>CINCINNATI | OH | 45202 | | NO | |
| 0040 | AMERICAN HOIST & DERRICK COMPANY<br>ST. PAUL | MN | 55107 | | NO | |
| A | BAY CITY STEEL CASTINGS DIVISION<br>BAY CITY | MI | 48706 | D3 | YES | |
| 0044 | AMERON, INC.<br>MONTEREY PARK | CA | 91754 | | YES | |
| A | AMERON STEEL & WIRE DIVISION<br>ETIWANDA | CA | 91739 | D3,F | YES | |
| 0048 | AMPCO-PITTSBURGH CORPORATION<br>MILWAUKEE | WI | 53201 | | NO | |
| A | WYCKOFF STEEL DIVISION<br>PITTSBURGH | PA | 15219 | | NO | |
| B | WYCKOFF STEEL DIVISION<br>AMBRIDGE | PA | 15003 | | NO | |
| C | WYCKOFF STEEL DIVISION<br>PLYMOUTH | MI | 48170 | | NO | |
| D | WYCKOFF STEEL DIVISION<br>CHICAGO | IL | 60690 | | NO | |
| E | WYCKOFF STEEL DIVISION<br>NEWARK | NJ | 07102 | | NO | |
| F | WYCKOFF STEEL DIVISION<br>PUTNAM | CT | 06260 | I1 | YES | |
| 0052 | AMSTED INDUSTRIES, INC.<br>CHICAGO | IL | 60690 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0052 | A | MAC WHYTE COMPANY<br>KENOSHA | WI | 53140 | | NO | |
| 0056 | | ANGELL NAIL & CHAPLET COMPANY<br>CLEVELAND | OH | 44105 | | NO | |
| 0060 | | ARMCO STEEL CORPORATION<br>MIDDLETOWN | OH | 45043 | A,B,C,D1,D2,E,F,G1,G3,<br>I2,I3,J1,J2,L1,L2 | YES | |
| | A | HAMILTON PLANT<br>HAMILTON | OH | 45011 | A,C | YES | |
| | B | ASHLAND WORKS<br>ASHLAND | KY | 41101 | B,C,D1,G1,G3,I2,J1,L1 | YES | |
| | C | AMBRIDGE WORKS<br>AMBRIDGE | PA | 15003 | G2,G4,I1 | YES | |
| | D | BUTLER WORKS<br>BUTLER | PA | 16001 | D3,E,F,G1,G3,H,I1,I2,I3<br>J1,K | YES | |
| | E | ZANESVILLE PLANT<br>ZANESVILLE | OH | 43701 | I3,J1 | YES | |
| | F | HOUSTON WORKS<br>HOUSTON | TX | 77015 | A,B,C,D3,E,G1,G2,G3,G4 | YES | |
| | G | KANSAS CITY WORKS<br>KANSAS CITY | MO | 64125 | D3,G1,G2,I1,L1 | YES | |
| | H | SAND SPRING WORKS<br>SAND SPRING | OK | 74063 | D3,F,G2 | YES | |
| | I | BALTIMORE WORKS<br>BALTIMORE | MD | 21203 | D3,G1,G2,H,I3,J1 | YES | |
| | J | NATIONAL SUPPLY COMPANY<br>TORRANCE | CA | 90509 | D3,E | YES | |
| | K | MARION WORKS<br>MARION | OH | 43302 | D3,F,G2 | YES | |
| | L | HITCO DIVISION<br>ATLANTA | GA | 30318 | I2 | YES | |
| | M | LEGGET & PLATT DIVISION<br>CARTHAGE | MO | 64836 | I1 | YES | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0060 N | ADVANCED MATERIALS DIVISION<br>HOUSTON | TX | 77044 | I3,J2,K | YES | |
| O | TUBE ASSOCIATES<br>HOUSTON | TX | 77028 | | NO | |
| P | WILDWOOD PLANT<br>WILDWOOD | FL | 32785 | I3,J2 | YES | |
| Q | UNION WIRE ROPE | | | | | |
| R | MIDDLETOWN FABRICATING<br>MIDDLETOWN | OH | 45042 | G4,L1 | YES | |
| S | UNION WIRE ROPE<br>KANSAS CITY | MO | 84126 | I1,L1 | YES | |
| 0064 | BARNES GROUP, INC.<br>BRISTOL | CT | 06010 | | NO | |
| A | WALLACE BARNES STEEL DIVISION<br>BRISTOL | CT | 06010 | | NO | |
| 0068 | ATLANTIC STEEL COMPANY<br>ATLANTA | GA | 30301 | D3,G1,G2,I1,I2,I3,K,L1 | YES | |
| A | ATLANTA BUILDING SYSTEMS, INC.<br>ATLANTA | GA | 30301 | | NO | |
| B | CARTERSVILLE FACILITY<br>CARTERSVILLE | GA | 30120 | D3,F,G2 | YES | |
| 0072 | ATLANTIC WIRE COMPANY<br>BRANFORD | CT | 08405 | | NO | |
| 0076 | AUBURN STEEL COMPANY, INC.<br>AUBURN | NY | 13021 | D3,F | YES | |
| 0080 | AUTOMATION INDUSTRIES, INC.<br>LOS ANGELES | CA | 90002 | | NO | |
| A | HARRIS TUBE DIVISION<br>LOS ANGELES | CA | 90002 | G4 | YES | |
| B | SOUTHWEST STEEL DRILLING MILLS, INC.<br>LOS ANGELES | CA | 90002 | D3 | YES | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0084 | | AZCON CORPORATION<br>KNOXVILLE | TN | 37921 | | NO | |
| | A | KNOXVILLE IRON DIVISION<br>KNOXVILLE | TN | 37921 | D3,F | NO | |
| 0088 | | BABCOCK & WILCOX<br>NEW YORK | NY | 10017 | | NO | |
| | A | TUBULAR PRODUCTS DIVISION<br>BEAVER FALLS | PA | 15010 | D3,E,G1,G2,G4,I1,I2,I3,<br>K | YES | |
| | B | TUBULAR PRODUCTS DIVISION<br>ALLIANCE | OH | 44601 | I1 | YES | |
| | C | TUBULAR PRODUCTS DIVISION<br>MILWAUKEE | WI | 53201 | G4,I3,K | YES | |
| | D | TUBULAR PRODUCTS DIVISION<br>BEAVER FALLS | PA | 15010 | G1,G2,I2,I3 | YES | |
| 0092 | | BARON DRAWN STEEL CORPORATION<br>TOLEDO | OH | 43607 | | NO | |
| 0096 | | BARRY STEEL CORPORATION<br>DETROIT | MI | 48238 | | NO | |
| 0104 | | BEKAERT STEEL WIRE CORPORATION<br>NEW YORK | NY | 10017 | | NO | |
| | A | BEKAERT STEEL WIRE CORPORATION<br>RUME | GA | 30161 | | NO | |
| | B | BEKAERT STEEL WIRE CORPORATION<br>RENO | NV | 89501 | | NO | |
| | C | BEKAERT STEEL WIRE CORPORATION<br>ACWORTH | GA | 30101 | | NO | |
| 0108 | | BERGER INDUSTRIES, INC.<br>NASPETH | NY | 11378 | | NO | |
| | A | BERGER INDUSTRIES, INC.<br>METUCHEN | NJ | 08840 | | NO | |
| 0112 | | BETHLEHEM STEEL CORPORATION<br>BETHLEHEM | PA | 18016 | A,B,C,D1,D3,E,G1,G2,I1 | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0112 | A | SPARROWS POINT PLANT<br>SPARROWS POINT | MD | 21219 | A,B,C,D1,D2,G1,G2,G3,<br>I1,I3,J1,J2,K,L1 | YES | |
| | B | LACKAWANNA PLANT<br>BUFFALO | NY | 14219 | A,B,C,D1,D2,E,G1,G2,G3,<br>I1,I2,J1,L1 | YES | |
| | C | JOHNSTOWN PLANT<br>JOHNSTOWN | PA | 15907 | A,B,C,D2,G1,G2,G3,I1,<br>I3,K | YES | |
| | D | BURNS HARBOR PLANT<br>CHESTERTON | IN | 46304 | A,B,C,D1,F,G1,G3,I1,I2,<br>J1,K | YES | |
| | E | STEELTON PLANT<br>STEELTON | PA | 17113 | D3,G1,G2,J2 | YES | |
| | F | LOS ANGELES PLANT<br>LOS ANGELES | CA | 90051 | D3,G1,G2,I1,K,L1 | YES | |
| | G | SEATTLE PLANT<br>SEATTLE | WA | 98124 | D3,G1,G2,I1,L1 | YES | |
| | H | WILLIAMSPORT PLANT<br>WILLIAMSPORT | PA | 17701 | I2,I3,L1 | YES | |
| | I | LEBANON PLANT<br>LEBANON | PA | 17042 | G2,I1,K,L1 | YES | |
| | J | SAN FRANCISCO PLANT<br>SAN FRANCISCO | CA | 94080 | G2 | YES | |
| | K | MORGANTOWN PLANT<br>MORGANTOWN | PA | 19543 | | NO | |
| 0116 | | BIRDSBORO CORPORATION<br>BIRDSBORO | PA | 19508 | D3 | YES | |
| 0120 | | BISHOP TUBE COMPANY<br>FRAZER | PA | 19355 | | NO | |
| 0124 | | BLAIR STRIP STEEL COMPANY<br>NEW CASTLE | PA | 16103 | | NO | |
| 0128 | | BLISS & LAUGHLIN INDUSTRIES, INC.<br>OAK BROOK | IL | 60521 | | NO | |
| | A | BLISS & LAUGHLIN STEEL COMPANY, DIVISION<br>HARVEY | IL | 60426 | | NO | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUECATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0128 B | BLISS & LAUGHLIN STEEL COMPANY, DIVISION<br>DETROIT | MI | 48089 | | NO | |
| C | BLISS & LAUGHLIN STEEL COMPANY, DIVISION<br>MEDINA | OH | 44256 | | NO | |
| D | BLISS & LAUGHLIN STEEL COMPANY, DIVISION<br>LOS ANGELES | CA | 90040 | | NO | |
| E | BLISS & LAUGHLIN STEEL COMPANY, DIVISION<br>SEATTLE | WA | 98108 | | NO | |
| F | BLISS & LAUGHLIN STEEL COMPANY, DIVISION<br>HOUSTON | TX | 77011 | | NO | |
| 0132 | BORDER STEEL MILL, INC.<br>VINTON | TX | 79912 | D3,F | YES | |
| 0136 | BORG-WARNER CORPORATION<br>CHICAGO | IL | 60604 | | NO | |
| A | BORG-WARNER STEEL, INC.<br>CHICAGO HEIGHTS | IL | 60411 | | NO | |
| B | CALUMET STEEL COMPANY<br>CHICAGO HEIGHTS | IL | 60411 | D3,F,G2 | YES | |
| C | FRANKLIN STEEL COMPANY<br>FRANKLIN | PA | 16323 | G2 | YES | |
| D | | | | | | SEE 0430C |
| E | INGERSOLL PRODUCTS DIVISION<br>CHICAGO | IL | 60643 | | NO | |
| 0140 | BORTZ COAL COMPANY<br>UNIONTOWN | PA | 15401 | | NO | |
| A | BORTZ COAL COMPANY<br>SMITHFIELD | PA | 15478 | | NO | |
| 0144 | BUCKEYE STEEL CASTINGS COMPANY<br>COLUMBUS | OH | 43215 | D3 | YES | |
| 0148 | BUCYRUS-ERIE COMPANY<br>SOUTH MILWAUKEE | WI | 53172 | D3 | YES | |

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0148 | A | GLASSPORT PLANT<br>GLASSPORT | PA | 15045 | D2,D3 | YES | SHUTDOWN |
| 0152 | | BUNDY CORPORATION<br>DETROIT | MI | 48226 | | NO | |
| | A | BUNDY CORPORATION<br>WINCHESTER | KY | 40391 | | NO | |
| | B | BUNDY CORPORATION<br>COLDWAVE | MI | 49036 | | NO | |
| | C | BUNDY CORPORATION<br>MT. CLEMENS | MI | 48043 | | NO | |
| | D | BUNDY CORPORATION<br>WARREN | MI | 48089 | | NO | |
| | E | BUNDY CORPORATION<br>HOMETOWN | PA | 18252 | | NO | |
| | F | BUNDY CORPORATION<br>CYNTHIANA | KY | 41031 | | NO | |
| | G | BUNDY CORPORATION<br>MALVERN | PA | 19355 | | NO | |
| 0156 | | CABOT CORPORATION<br>BOSTON | MA | 02110 | | NO | |
| | A | MACHINERY DIVISION<br>PAMPA | TX | 79065 | D3,E | YES | |
| | B | STELLITE DIVISION<br>KOKOMO | IN | 46901 | B,D3 | YES | |
| 0160 | | CALIFORNIA STEEL & TUBE<br>CITY OF INDUSTRY | CA | 91744 | | NO | |
| 0164 | | CAL-METAL CORPORATION<br>IRWINDALE | CA | 91706 | | NO | |
| 0168 | | CAMERON IRON WORKS, INC.<br>HOUSTON | TX | 77001 | D3,E | YES | |
| 0172 | | G.O. CARLSON, INC.<br>THORNDALE | PA | 19372 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0174 | | CARONDELET COKE CORPORATION<br>ST. LOUIS | MO | 63111 | A | YES | FORMERLY 0348A |
| 0176 | | CARPENTER TECHNOLOGY CORPORATION<br>READING | PA | 19601 | D3,G1,G2,G3,H,I1,I2,I3,<br>J1,K | YES | |
| | A | CARPENTER STEEL DIVISION<br>BRIDGEPORT | CT | 06607 | D3 | YES | |
| | B | CARPENTER STEEL DIVISION<br>READING | PA | 19601 | | NO | |
| | C | UNION PLANT TUBE DIVISION<br>UNION | NJ | 07083 | I3,J2 | YES | |
| | D | JAMESBURG PLANT TUBE DIVISION<br>CRANBURY | NJ | 08512 | I3,J2 | YES | SHUTDOWN |
| 0180 | | CASCADE STEEL ROLLING MILLS, INC.<br>MCMINNVILLE | OR | 97128 | D3,F | NO | |
| 0184 | | CAVERT WIRE COMPANY, INC.<br>UNIONTOWN | PA | 15401 | | NO | |
| 0188 | | CECO CORPORATION<br>CHICAGO | IL | 60650 | | NO | |
| | A | LEMONT MANUFACTURING COMPANY<br>LEMONT | IL | 60439 | D3,G1 | YES | |
| | B | MILTON MANUFACTURING COMPANY<br>MILTON | PA | 17847 | D3,G1,G2 | YES | |
| | C | SOUTHERN ELECTRIC STEEL COMPANY<br>BIRMINGHAM | AL | 35202 | D3,F,G2 | YES | |
| 0192 | | CENTRAL STEEL TUBE COMPANY<br>CLINTON | IA | 52732 | | NO | |
| 0196 | | CF&I STEEL CORPORATION<br>PUEBLO | CO | 81002 | | NO | |
| | A | PUEBLO PLANT<br>PUEBLO | CO | 81004 | A,B,C,D1,D3,F,G1,G2,G4,<br>I1,L1 | YES | |
| 0200 | | CHAMPION STEEL COMPANY<br>ORWELL | OH | 44076 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0204 | CHAPARAL STEEL COMPANY<br>MIDLOTHIAN | TX | 76065 | D3,F | YES | |
| 0208 | CHRISTIE COAL & COKE COMPANY<br>NORTON | VA | 24273 | | NO | |
| 0212 | CITIZENS GAS & COKE UTILITY<br>INDIANAPOLIS | IN | 46202 | A | YES | |
| 0216 | COLUMBIA STEEL CASTING COMPANY, INC.<br>PORTLAND | OR | 97203 | D3 | YES | |
| 0220 | COLUMBIA TOOL STEEL COMPANY<br>CHICAGO HEIGHTS | IL | 60411 | | NO | |
| 0224 | COLUMBIAN STEEL TANK COMPANY<br>KANSAS CITY | MO | 64101 | | NO | |
| 0226 | COMMERCIAL METALS, INC.<br>DALLAS | TX | 75247 | D3,F | YES | FORMERLY 0764 |
| A | ARKANSAS STEEL ROLLING MILLS, INC.<br>MAGNOLIA | AR | 71753 | | NO | FORMERLY 0764A |
| 0228 | CONSOLIDATED METALS CORPORATION<br>NEWTON | NJ | 07860 | | NO | |
| 0232 | CONSTELLATION STEEL MILL EQUIPMENT CORP.<br>CINCINNATI | OH | 45216 | | NO | |
| 0236 | CONTINENTAL COPPER & STEEL INDUSTRIES<br>CRANFORD | NJ | 07016 | | NO | |
| A | BRADBURN ALLOY STEEL DIVISION<br>LOWER BURRELL | PA | 15068 | D3 | YES | |
| 0240 | COPPERWELD CORPORATION<br>PITTSBURGH | PA | 15219 | | NO | |
| A | COPPERWELD STEEL COMPANY<br>WARREN | OH | 44482 | D3,E,F,G1,G2,I1 | YES | |
| B | OHIO STEEL TUBE COMPANY<br>SHELBY | OH | 44875 | G4,I1,K | YES | |
| C | REGAL TUBE COMPANY<br>CHICAGO | IL | 60638 | G4,I1,K | YES | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0240 | D | BIMETALLICS DIVISION<br>GLASSPORT | PA | 15045 | | NO | |
| | E | FLEXCO WIRE DIVISION<br>OSWEGO | NY | 13126 | | NO | |
| 0244 | | COREY STEEL COMPANY<br>CICERO | IL | 60650 | | NO | |
| 0248 | | COLT INDUSTRIES<br>NEW YORK | NY | 10022 | | NO | |
| | A | ALLOY DIVISION<br>MIDLAND | PA | 15059 | A,C,D1,G1,G2,I1 | YES | |
| | B | STAINLESS STEEL DIVISION<br>MIDLAND | PA | 15059 | D3,E,F,H,I3,J1 | YES | |
| | C | SPECIALTY METALS DIVISION<br>GEDDES | NY | 13209 | G1,G2,I3,J1,K | YES | |
| | D | TRENT TUBE DIVISION<br>EAST TROY | WI | 53120 | | NO | |
| | E | TRENT TUBE DIVISION<br>FULLERTON | CA | 92634 | | NO | |
| | F | TRENT TUBE DIVISION<br>CARROLLTON | GA | 30117 | | NO | |
| | G | TRENT TUBE DIVISION<br>BREMEN | GA | 30110 | | NO | |
| 0252 | | CUMBERLAND STEEL COMPANY<br>CUMBERLAND | MD | 21502 | | NO | |
| 0256 | | CYCLOPS CORPORATION<br>PITTSBURGH | PA | 15228 | | NO | |
| | A | DETROIT STRIP DIVISION<br>DETROIT | MI | 48217 | I1,J1 | YES | |
| | B | DETROIT STRIP DIVISION<br>NEW HAVEN | CT | 06507 | I1,J1 | YES | |
| | C | EMPIRE DETROIT STEEL DIVISION<br>MANSFIELD | OH | 44901 | D1,D3 | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0256 D | EMPIRE DETROIT STEEL DIVISION<br>DOVER | OH | 44622 | | NO | |
| E | EMPIRE DETROIT STEEL DIVISION<br>PORTSMOUTH | OH | 45662 | A,C,D2 | YES | |
| F | SAWHILL TUBULAR DIVISION<br>WHEATLAND | PA | 16161 | I1,I3,J2 | YES | |
| G | SAWHILL TUBULAR DIVISION<br>SHARON | PA | 16146 | G4,I1,L1 | YES | |
| H | SAWHILL TUBULAR DIVISION<br>MINNEAPOLIS | MN | 55406 | | NO | |
| I | TEX-TUBE DIVISION<br>HOUSTON | TX | 77007 | | NO | |
| J | UNIVERSAL CYCLOPS SPECIALTY STEEL DIV.<br>PITTSBURGH | PA | 15228 | | NO | |
| K | BRIDGEVILLE PLANT<br>BRIDGEVILLE | PA | 15017 | D3,G1,G2,H | YES | |
| L | PITTSBURGH PLANT<br>PITTSBURGH | PA | 15201 | G3,H,I3,J1 | YES | |
| M | ALIQUIPPA FORGE DEPARTMENT<br>ALIQUIPPA | PA | 15001 | | NO | |
| N | TITUSVILLE PLANT<br>TITUSVILLE | PA | 16354 | D3,G2,H,I3,J1,K | YES | |
| O | COSHOCTON PLANT<br>COSHOCTON | OH | 43812 | H,I3,J1,K | YES | |
| 0260 | DAMASCUS STEEL CASTING COMPANY<br>NEW BRIGHTON | PA | 15066 | D3 | YES | |
| 0264 | DAVIS WALKER CORPORATION<br>LOS ANGELES | CA | 90040 | | NO | |
| A | DAVIS WALKER CORPORATION<br>CITY OF INDUSTRY | CA | 91744 | | NO | |
| B | DAVIS WALKER CORPORATION<br>RIVERSIDE | CA | 92501 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME | CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 0264 | C | DAVIS WALKER CORPORATION | KENT | WA | 98031 | | NO | |
| 0272 | | DONNER-HANNA COKE CORPORATION | BUFFALO | NY | 14220 | A | NO | |
| 0276 | | DONOVAN STEEL TUBE COMPANY | TOLEDO | OH | 43611 | | NO | |
| 0280 | | EASTERN GAS & FUEL ASSOCIATION | PHILADELPHIA | PA | 19137 | | NO | |
| | A | EASTERN ASSOCIATION COAL CORPORATION | PITTSBURGH | PA | 15219 | | NO | |
| | B | PHILADELPHIA COKE DIVISION | PHILADELPHIA | PA | 19137 | A | YES | |
| 0284 | | EASTMET CORPORATION | COCKEYSVILLE | MD | 21030 | | NO | |
| | A | EASTERN STAINLESS STEEL COMPANY | BALTIMORE | MD | 21224 | F,G3,H,I3,J1 | YES | |
| 0288 | | EDGEWATER CORPORATION | OAKMONT | PA | 15139 | | NO | |
| | A | EDGEWATER STEEL COMPANY | OAKMONT | PA | 15139 | D3 | YES | |
| | C | JANNEY CYLINDER COMPANY | PHILADELPHIA | PA | 19136 | | NO | |
| 0292 | | EDWARDS COMPANY, E.H. | SAN FRANCISCO | CA | 94080 | | NO | |
| 0296 | | ELECTRALLOY CORPORATION | NEW YORK | NY | 10019 | | NO | |
| | A | ELECTRALLOY CORPORATION | OIL CITY | PA | 16301 | | NO | |
| 0300 | | ELLIOT BROTHERS STEEL COMPANY | NEW CASTLE | PA | 16103 | | NO | |
| 0304 | | EMPIRE COKE COMPANY | HOLT | AL | 35401 | | NO | |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0308 | EMPIRE STEEL CASTINGS, INC.<br>READING | PA | 19603 | | NO | |
| A | EMPIRE STEEL CASTINGS, INC.<br>TEMPLE | PA | 19560 | | NO | |
| 0312 | FITZSIMMONS STEEL COMPANY<br>YOUNGSTOWN | OH | 44501 | | NO | |
| 0316 | FLORIDA STEEL CORPORATION<br>TAMPA | FL | 33623 | D3,F,G2 | YES | |
| A | INDIANTOWN STEEL MILL DIVISION<br>INDIANTOWN | FL | 33456 | D3,F,G2 | YES | |
| B | CHARLOTTE STEEL MILL DIVISION<br>CHARLOTTE | NC | 28213 | D3,F,G2 | YES | |
| C | JACKSONVILLE STEEL MILL DIVISION<br>JACKSONVILLE | FL | 32234 | G2 | YES | |
| 0320 | FORD MOTOR COMPANY<br>DEARBORN | MI | 48121 | A,C,D1,D3,G1,G2,G3,I2,<br>J1 | YES | |
| 0324 | FORT HOWARD STEEL & WIRE<br>GREEN BAY | WI | 54305 | | NO | |
| 0328 | FOSBRINK MACHINE COMPANY<br>CONNELLSVILLE | PA | 15425 | | NO | |
| 0332 | GENERAL CABLE CORPORATION<br>GREENWICH | CT | 06830 | | NO | |
| A | INDIANA STEEL & WIRE DIVISION<br>MUNCIE | IN | 47302 | | NO | |
| 0336 | GENERAL MOTORS CORPORATION<br>DETROIT | MI | 48202 | | NO | |
| A | GENERAL MOTORS CORPORATION<br>WAUKEGAN | IL | 60085 | | NO | |
| 0340 | GENERAL STEEL INDUSTRIES, INC.<br>ST. LOUIS | MO | 63105 | | NO | |
| A | NATIONAL ROLL DIVISION<br>AVONMORE | PA | 15618 | D3 | NO | |

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0344 | | GILBERT & BENNETT MANUFACTURING COMPANY<br>GEORGETOWN | CT | 06829 | | NO | |
| | A | GILBERT & BENNETT MANUFACTURING COMPANY<br>BLUE ISLAND | IL | 60406 | | NO | |
| | B | COATINGS ENGINEERING CORPORATION<br>SUDBURY | MA | 01776 | | NO | |
| 0348 | | GREAT LAKES CARBON CORPORATION<br>NEW YORK | NY | 10017 | | NO | |
| | A | | | | | | SEE 0174 |
| 0352 | | GREER STEEL COMPANY<br>DOVER | OH | 44622 | | NO | |
| | A | GREER STEEL COMPANY<br>FERNDALE | MI | 48220 | | NO | |
| 0356 | | HARSCO CORPORATION<br>CAMP HILL | PA | 17011 | | NO | |
| | A | HARRISBURG STEEL COMPANY<br>HARRISBURG | PA | 17105 | | NO | |
| | B | QUAKER ALLOY CASTING COMPANY<br>MYERSTOWN | PA | 17067 | D3 | YES | |
| 0360 | | HAWAIIAN WESTERN STEEL LTD.<br>EWA | HI | 96706 | D3 | YES | |
| 0364 | | HEPPENSTALL COMPANY<br>PITTSBURGH | PA | 15201 | | NO | |
| | A | MIDVALE-HEPPENSTALL<br>PHILADELPHIA | PA | 19140 | | NO | |
| 0368 | | HOOVER BALL & BEARING COMPANY<br>SOLON | OH | 44139 | | NO | |
| | A | CUYAHOGA STEEL & WIRE DIVISION<br>SOLON | OH | 44139 | | NO | |
| 0372 | | HYDE PARK FOUNDRY & MACHINE COMPANY<br>HYDE PARK | PA | 15641 | | NO | |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0376 | IGOE BROTHERS, INC.<br>NEWARK | NJ | 07114 | | NO | |
| 0380 | INDIANA GAS & CHEMICAL CORPORATION<br>TERRE HAUTE | IN | 47808 | | NO | |
| 0384 | INLAND STEEL COMPANY<br>CHICAGO | IL | 60603 | | NO | |
| A | INDIANA HARBOR WORKS<br>EAST CHICAGO | IN | 46312 | A,B,C,D1,D2,D3,F,G1,G2,<br>G3,I1,I2,J1,K,L1 | YES | |
| 0388 | INTERCOASTAL STEEL CORPORATION<br>CHESAPEAKE | VA | 23324 | | NO | |
| A | GILMERTON PLANT<br>CHESAPEAKE | VA | 23323 | D3 | YES | |
| 0392 | INTERCONTINENTAL STEEL CORPORATION<br>CHICAGO | IL | 60628 | | NO | |
| 0396 | INTERLAKE, INC.<br>OAK BROOK | IL | 60521 | | NO | |
| A | IRON & STEEL DIVISION<br>SOUTH CHICAGO | IN | 60617 | A,B,C | YES | |
| C | TOLEDO PLANT<br>TOLEDO | OH | 43605 | A,C | YES | SHUTDOWN,COKEMAKING<br>SOLD TO 0464 |
| D | RIVERDALE STATION<br>RIVERDALE | IL | 60627 | D1,G1,G2,G3,I2,J1 | YES | |
| E | NEWPORT MILDER PLANT<br>NEWPORT | KY | 41072 | D3,G1,G4,I1,J1 | YES | |
| F | GARY STEEL SUPPLY COMPANY<br>BLUE ISLAND | IL | 60406 | | NO | |
| G | BEVERLY PLANT<br>BEVERLY | OH | 45715 | | NO | |
| H | ALABAMA METALLURGICAL CORPORATION<br>SELINA | AL | 36701 | | NO | |
| I | HOEGANAES CORPORATION<br>RIVERTON | NJ | 08077 | | NO | |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0400 | | | | | | SEE 0946 |
| A | | | | | | SEE 0946A |
| 0402 | IRONTON COKE COMPANY<br>IRONTON | OH | 45638 | A | YES | FORMERLY 0024C |
| 0404 | ITT HARPER, INC.<br>MORTON GROVE | IL | 60053 | D3 | NO | |
| 0408 | IVY STEEL & WIRE COMPANY<br>JACKSONVILLE | FL | 32205 | | NO | |
| 0412 | JACKSON IRON & STEEL COMPANY<br>JACKSON | OH | 45640 | | NO | |
| 0416 | JAMES STEEL & TUBE COMPANY<br>ROYAL OAK | MI | 48067 | | NO | |
| A | JAMES STEEL & TUBE COMPANY<br>MADISON HEIGHTS | MI | 48071 | | NO | |
| 0420 | JERSEY SHORE STEEL COMPANY<br>JERSEY SHORE | PA | 17740 | | NO | |
| A | JERSEY SHORE STEEL COMPANY<br>SOUTH AVIS | PA | 17721 | | NO | |
| 0424 | JESSOP STEEL COMPANY<br>WASHINGTON | PA | 15301 | D3,G1,G2,G3,H,I3 | YES | |
| A | GREEN RIVER STEEL<br>OWENSBORO | KY | 42301 | D3,E | YES | |
| 0426 | JIM WALTER RESOURCES<br>BIRMINGHAM | AL | 35202 | A,C | YES | FORMERLY 0848 |
| 0428 | JEWELL SMOKELESS COAL CORPORATION<br>KNOXVILLE | TN | 37902 | | NO | |
| A | JEWELL SMOKELESS COAL CORPORATION<br>VANSANT | VA | 24656 | | NO | |
| 0430 | JOHNSON STEEL & WIRE COMPANY<br>WORCESTER | MA | 01607 | | NO | FORMERLY 0920H |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0430 A | AKRON PLANT<br>AKRON | OH | 44309 | | NO | FORMERLY 0920I |
| B | LOS ANGELES PLANT<br>LOS ANGELES | CA | 90059 | | NO | FORMERLY 0920J |
| C | INGERSOLL STEEL<br>NEW CASTLE | IN | 47362 | D3,G1,G3 | YES | FORMERLY 0136D |
| 0432 | JONES & LAUGHLIN STEEL CORPORATION<br>PITTSBURGH | PA | 15230 | | YES | |
| A | ALIQUIPPA WORKS<br>ALIQUIPPA | PA | 15001 | A,B,C,D1,F,G1,G2,G3,I1,<br>J1,J2,K,L1 | YES | |
| B | PITTSBURGH WORKS<br>PITTSBURGH | PA | 15203 | A,C,D2,G1,G2,G3,I1,J1,<br>L1 | YES | |
| C | CLEVELAND WORKS<br>CLEVELAND | OH | 44101 | B,C,D1,D3,G1,G3,I2,J1 | YES | |
| D | HENNEPIN WORKS<br>HENNEPIN | IL | 61327 | I2,J1,L1 | YES | |
| E | OIL CITY WORKS<br>OIL CITY | PA | 16301 | I1,I3 | YES | |
| F | JONES & LAUGHLIN STEEL CORPORATION<br>GAINESVILLE | TX | 76240 | | NO | |
| G | JONES & LAUGHLIN STEEL CORPORATION<br>MUNCY | PA | 17756 | | NO | |
| H | JONES & LAUGHLIN STEEL CORPORATION<br>HAMMOND | IN | 46320 | | NO | |
| I | JONES & LAUGHLIN STEEL CORPORATION<br>WILLIMANTIC | CT | 06226 | | NO | |
| J | WARREN PLANT<br>WARREN | MI | 48090 | D3,G1,G2 | YES | |
| K | JONES & LAUGHLIN STEEL CORPORATION<br>LOUISVILLE | OH | 44641 | | NO | |
| L | YOUNGSTOWN WORKS<br>YOUNGSTOWN | OH | 44501 | H,I1,I3 | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0432 M | INDIANAPOLIS WORKS<br>INDIANAPOLIS | IN | 46241 | I1 | YES | |
| N | JONES & LAUGHLIN STEEL CORPORATION<br>LOS ANGELES | CA | 90052 | | NO | |
| O | JONES & LAUGHLIN STEEL CORPORATION<br>NILES | OH | 44446 | | NO | |
| P | JONES & LAUGHLIN STEEL CORPORATION<br>NEW KENSINGTON | PA | 15068 | | NO | |
| 0436 | JORGENSEN COMPANY, E.M.<br>LOS ANGELES | CA | 90054 | D3,E | YES | |
| 0440 | JOSLYN MANUFACTURING & SUPPLY COMPANY<br>CHICAGO | IL | 60606 | | NO | |
| A | JOSLYN STAINLESS STEELS DIVISION<br>FORT WAYNE | IN | 46804 | D3,G1,G2,H,I3 | YES | |
| 0444 | JUDSON STEEL CORPORATION<br>EMERYVILLE | CA | 94608 | D3,F | NO | |
| 0448 | KAISER STEEL CORPORATION<br>OAKLAND | CA | 94612 | | NO | |
| A | STEEL MANUFACTURING DIVISION<br>FONTANA | CA | 92335 | A,B,C,D1,D2,G1,G2,G3,G4<br>,I2,J1,K,L1 | YES | |
| B | KAISER STEEL CORPORATION<br>NAPA | CA | 94558 | | NO | |
| 0452 | KENNAMETAL, INC.<br>LATROBE | PA | 15650 | | NO | |
| 0456 | KENTUCKY ELECTRICAL STEEL COMPANY<br>ASHLAND | KY | 41101 | | NO | |
| A | KENTUCKY ELECTRICAL STEEL COMPANY<br>ASHLAND | KY | 41101 | D3,F | YES | |
| 0460 | KEYSTONE CONSOLIDATED INDUSTRIES, INC.<br>PEORIA | IL | 61601 | | YES | |
| A | KEYSTONE STEEL AND WIRE<br>PEORIA | IL | 61641 | D3,F,G1,G2,I2,L1 | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0460 B | KEYSTONE STEEL AND WIRE<br>CHICAGO HEIGHTS | IL | 60411 | G2 | YES | |
| C | SANTA CLARA PLANT<br>SANTA CLARA | CA | 95052 | I1,L1 | YES | |
| D | MID-STATES STEEL AND WIRE<br>CRAWFORDSVILLE | IN | 47933 | I1,K,L1 | YES | |
| E | JACKSONVILLE PLANT<br>JACKSONVILLE | FL | 32201 | I1,L1 | YES | |
| F | MID-STATES STEEL AND WIRE<br>SHERMAN | TX | 75091 | I1,L1 | YES | |
| G | GREENVILLE PLANT<br>GREENVILLE | MS | 38701 | I1,K,L1 | YES | |
| H | CHICAGO STEEL AND WIRE<br>CHICAGO | IL | 60617 | I1,K,L1 | YES | |
| 0464 | KOPPERS COMPANY, INC.<br>PITTSBURGH | PA | 15219 | | YES | |
| A | ORGANIC MATERIALS DIVISION<br>PITTSBURGH | PA | 15219 | | NO | |
| B | ST. PAUL DIVISION<br>ST. PAUL | MN | 55104 | A | YES | |
| C | ERIE DIVISION<br>ERIE | PA | 16512 | A | YES | |
| D | ORGANIC MATERIALS DIVISION<br>KEARNY | NJ | 07032 | | NO | |
| E | WOODARD COKE<br>BESSEMER | AL | 35020 | A | YES | |
| 0468 | KORF INDUSTRIES, INC.<br>CHARLOTTE | NC | 28280 | | NO | |
| A | MIDREX CORPORATION<br>CHARLOTTE | NC | 28280 | | NO | |
| B | GEORGETOWN STEEL CORPORATION<br>GEORGETOWN | SC | 29440 | D3,F,G2 | YES | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0468 | C | GEORGETOWN FERREDUCTION CORPORATION<br>GEORGETOWN | SC | 29440 | | NO | |
| | D | ANDREWS WIRE CORPORATION<br>ANDREWS | SC | 29510 | | NO | |
| | E | ANDREWS WIRE OF TENNESSEE<br>GALLATIN | TN | 37066 | | NO | |
| | F | GEORGETOWN TEXAS STEEL CORPORATION<br>BEAUMONT | TX | 77704 | D3,F | NO | |
| 0472 | | MICHAEL KRAL INDUSTRIES, INC.<br>NEW YORK | NY | 10019 | | NO | |
| | A | KOKOMO TUBE COMPANY<br>KOKOMO | IA | 46901 | | NO | |
| | B | VENANGO METALLURGICAL PRODUCTS<br>OIL CITY | PA | 16301 | | NO | |
| 0476 | | LACLEDE STEEL COMPANY<br>ST. LOUIS | MO | 63102 | | YES | |
| | A | ALTON PLANT<br>ALTON | IL | 62002 | D3,F,G1,G2,G3,G4,I3,K, L1 | YES | |
| | B | MADISON PLANT<br>MADISON | IL | 62060 | | NO | |
| | C | BEAUMONT PLANT<br>BEAUMONT | TX | 77706 | | NO | |
| | D | DALLAS PLANT<br>DALLAS | TX | 75206 | | NO | |
| | E | MEMPHIS PLANT<br>MEMPHIS | TN | 38107 | | NO | |
| | F | NEW ORLEANS PLANT<br>NEW ORLEANS | LA | 70126 | | NO | |
| | G | TAMPA PLANT<br>TAMPA | FL | 33611 | | NO | |
| 0480 | | LASALLE STEEL COMPANY<br>CHICAGO | IL | 60680 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0480 | A | HAMMOND PLANT<br>HAMMOND | IN | 46327 | | NO | |
| | B | KEYSTONE DRAWN STEEL COMPANY<br>SPRING CITY | PA | 19475 | | NO | |
| | C | FLUID POWER DIVISION<br>CHICAGO | IL | 60680 | | NO | |
| | D | FLUID POWER DIVISION<br>GRIFFITH | IN | 46319 | | NO | |
| 0488 | | LOFLAND STEEL MILL, INC.<br>OKLAHOMA CITY | OK | 73108 | | NO | |
| 0492 | | LONE STAR STEEL COMPANY<br>DALLAS | TX | 75235 | | NO | |
| | A | LONE STAR STEEL COMPANY<br>LONE STAR | TX | 75668 | A,B,C,D2,G1,G3,I1,J2,K,<br>L1 | YES | |
| | B | LONE STAR STEEL COMPANY<br>FORT COLLINS | CO | 80521 | | NO | |
| 0496 | | LUKENS STEEL COMPANY<br>COATESVILLE | PA | 19320 | D3,E,F,I3 | YES | |
| 0500 | | MADISON WIRE COMPANY<br>BUFFALO | NY | 14220 | | NO | |
| 0504 | | MAGNA CORPORATION<br>FLOWOOD | MS | 39208 | | YES | |
| | A | MISSISSIPPI STEEL DIVISION<br>FLOWOOD | MS | 39208 | D,F | YES | |
| 0508 | | MARATHON MANUFACTURING COMPANY<br>HOUSTON | TX | 77002 | | NO | |
| | A | MARATHON LETOURNEAU COMPANY<br>LONGVIEW | TX | 75601 | D3 | YES | |
| | B | MARATHON STEEL COMPANY<br>PHOENIX | AZ | 85005 | | NO | |
| | C | ROLLING MILL DIVISION<br>TEMPE | AZ | 85282 | D3 | YES | |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0512 | MARKIN TUBING, INC.<br>WYOMING | NY | 14591 | | NO | |
| 0516 | MARYLAND SPECIALTY WIRE, INC.<br>COCKEYSVILLE | MD | 21030 | | NO | |
| 0520 | MCCONWAY AND TORLEY CORPORATION<br>PITTSBURGH | PA | 15201 | D3 | YES | |
| 0524 | MCINNES STEEL COMPANY<br>CORRY | PA | 16407 | | NO | |
| 0528 | MCLOUTH STEEL CORPORATION<br>DETROIT | MI | 48209 | H,J1,K | YES | |
| A | TRENTON PLANT<br>TRENTON | MI | 48183 | C,D1,D3,F,G1,G3,I1 | YES | |
| B | GIBRALTAR PLANT<br>GIBRALTAR | MI | 48173 | I2,J1 | YES | |
| 0532 | MEAD CORPORATION<br>DAYTON | OH | 45402 | | NO | |
| B | CHATTANOOGA DIVISION<br>CHATTANOOGA | TN | 37401 | | NO | |
| 0536 | MERCER ALLOYS CORPORATION<br>GREENVILLE | PA | 16125 | | NO | |
| 0538 | MERCIER CORPORATION<br>BIRMINGHAM | MI | 48001 | | NO | |
| A | ERIE COKE AND CHEMICAL COMPANY<br>FAIRPORT HARBOR | OH | 44077 | | NO | |
| 0540 | MERIDIAN INDUSTRIES, INC.<br>SOUTHFIELD | MI | 48075 | | NO | |
| A | FORMED TUBES, INC.<br>STURGIS | MI | 49091 | | NO | |
| B | FORMED TUBES, INC.<br>HALEYVILLE | AL | 35565 | | NO | |
| C | FORMED TUBES, INC.<br>ALBION | IN | 46701 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY STATE ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|
| 0544 | MESTA MACHINE COMPANY<br>PITTSBURGH PA 15230 | | NO | |
| A | MESTA MACHINE COMPANY<br>PITTSBURGH PA 15230 | D2,D3 | YES | |
| B | MESTA MACHINE COMPANY<br>NEW CASTLE PA 16101 | | NO | |
| 0548 | | | | SEE 0678 |
| A | | | | SEE 0678A |
| B | | | | SEE 0678B |
| C | | | | SEE 0678C |
| D | | | | SEE 0678D |
| E | | | | SEE 0678E |
| 0552 | MID-AMERICA STEEL CORPORATION<br>CLEVELAND OH 44127 | | NO | |
| 0556 | MID-WEST WIRE COMPANY<br>CLEVELAND OH 44104 | | NO | |
| 0560 | MINNEAPOLIS ELECTRIC STEEL CASTINGS CO.<br>MINNEAPOLIS MN 55421 | D3 | YES | |
| 0564 | MISSOURI ROLLING MILL CORPORATION<br>ST. LOUIS MO 63143 | | NO | |
| 0568 | MOLTRUP STEEL PRODUCTS COMPANY<br>BEAVER FALLS PA 15010 | | NO | |
| 0572 | MSL INDUSTRIES, INC.<br>PIQUA OH 45356 | | NO | |
| A | MIAMI INDUSTRIES, DIVISION<br>PIQUA OH 45356 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0576 | | NATIONAL FORGE COMPANY<br>IRVINE | PA | 16329 | D3,E | YES | |
| | A | ERIE DIVISION<br>ERIE | PA | 16512 | D3,E | YES | |
| 0580 | | NATIONAL STANDARD COMPANY<br>NILES | MI | 49120 | I1,I2,I3,K | YES | |
| | A | WOVEN PRODUCTS DIVISION<br>CORBIN | KY | 40701 | I2,K,L1 | YES | |
| | B | MT. JOY PLANT<br>MT. JOY | PA | 17552 | I2,K | NO | |
| | C | ATHENIA STEEL DIVISION<br>CLIFTON | NJ | 07015 | I1,I2,J1 | YES | |
| | D | COLUMBIANA PLANT<br>COLUMBIANA | AL | 35051 | I2,K | NO | |
| | E | AKRON PLANT<br>AKRON | OH | 44310 | I2,K | NO | |
| | F | LOS ANGELES PLANT<br>LOS ANGELES | CA | 90001 | I2 | NO | |
| | G | WORCESTER WIRE DIVISION<br>WORCESTER | MA | 01603 | I3,K,L1 | YES | |
| 0584 | | NATIONAL STEEL<br>PITTSBURGH | PA | 15219 | | YES | |
| | A | GREAT LAKES STEEL DIVISION<br>DETROIT | MI | 48229 | D1,D3,G1,I2,J1 | YES | |
| | B | GREAT LAKES STEEL DIVISION<br>DETROIT | MI | 48229 | A,B,C,G3 | YES | |
| | C | GRANITE CITY STEEL DIVISION<br>GRANITE CITY | IL | 62040 | A,B,C,D1,G1,G3,I2,J1,L1 | YES | |
| | D | THE HANNA FURNACE CORPORATION<br>BUFFALO | NY | 14240 | C | YES | |
| | E | MIDWEST STEEL DIVISION<br>PORTAGE | IN | 46368 | I1,J1,K,L1 | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0584 | F | WEIRTON STEEL<br>WEIRTON | WV | 26062 | A,B,C,D1,E,F,G1,G2,G3,I<br>1,J1,L1 | YES | |
| | G | STEUBENVILLE PLANT<br>STEUBENVILLE | PA | 43952 | | NO | |
| | H | NATIONAL PIPE AND TUBE<br>LIBERTY | TX | 77575 | J2 | YES | |
| 0588 | | NAYLOR PIPE COMPANY<br>CHICAGO | IL | 60619 | | NO | |
| 0592 | | NEW ENGLAND HIGH CARBON WIRE CORPORATION<br>MILLBURY | MA | 01527 | | NO | |
| 0596 | | NEW JERSEY STEEL & STRUCTURAL CORPORATION<br>SAYREVILLE | NJ | 08872 | D3,F | YES | |
| 0600 | | NEWMAN-CROSBY STEEL, INC.<br>PAWTUCKET | RI | 02861 | | NO | |
| 0604 | | NEWPORT NEWS SHIP BUILDING & DRYDOCK CO.<br>NEWPORT NEWS | VA | 23607 | | NO | |
| 0608 | | NORTH STAR STEEL COMPANY<br>ST. PAUL | MN | 55165 | | NO | |
| | A | WILTON PLANT<br>WILTON | IA | 52778 | D3,F | YES | |
| 0612 | | NORTHWESTERN STEEL AND WIRE COMPANY<br>STERLING | IL | 61081 | D3,G1,G2,I1,I2,L1 | YES | |
| 0616 | | NORTHWEST STEEL ROLLING MILLS, INC.<br>SEATTLE | WA | 98107 | | NO | |
| | A | KENT PLANT<br>KENT | WA | 98031 | D3 | YES | |
| 0620 | | NUCOR CORPORATION<br>CHARLOTTE | NC | 28211 | | NO | |
| | A | NUCOR STEEL<br>DARLINGTON | SC | 29532 | D3,F | YES | |
| | B | NUCOR STEEL<br>NORFOLK | NC | 68701 | D3,F | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0620 | C | NUCOR STEEL<br>JEWETT | TX | 75846 | D3,F | YES | |
| 0624 | | GILMORE STEEL CORPORATION<br>PORTLAND | OR | 97208 | | YES | |
| | A | OREGON STEEL MILLS DIVISION<br>PORTLAND | OR | 97209 | | NO | |
| | B | RIVERGATE PLANT<br>PORTLAND | OR | 97203 | D3 | YES | |
| 0628 | | OWEN ELECTRIC STEEL OF SOUTH CAROLINA<br>COLUMBIA | SC | 29202 | | NO | |
| | A | OWEN ELECTRIC STEEL OF SOUTH CAROLINA<br>CAYCE | SC | 29033 | D3 | YES | |
| 0632 | | PACIFIC STATES STEEL CORPORATION<br>UNION CITY | CA | 94587 | | NO | |
| 0636 | | PACIFIC TUBE COMPANY<br>LOS ANGELES | CA | 90040 | G4,I1,I3,K | YES | |
| 0640 | | PENN-DIXIE STEEL COMPANY<br>KOKOMO | IN | 46901 | D3,G1,G2,I1,L1 | YES | |
| | A | PENN-DIXIE STEEL COMPANY<br>JOLIET | IL | 60434 | | NO | |
| | B | ENTERPRISE WIRE COMPANY<br>BLUE ISLAND | IL | 60406 | | NO | |
| | C | HAUSMAN CORPORATION<br>KOKOMO | IN | 46901 | | NO | |
| | D | HAUSMAN CORPORATION<br>DENVER | CO | 80203 | | NO | |
| | E | CENTERVILLE DIVISION<br>CENTERVILLE | IA | 52544 | D3 | YES | |
| 0644 | | PETTIBONE CORPORATION<br>CHICAGO | IL | 60651 | | NO | |
| 0648 | | PHILADELPHIA STEEL AND WIRE COMPANY<br>PHILADELPHIA | PA | 19154 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0652 | PHOENIX STEEL CORPORATION<br>CLAYMONT | DE | 19703 | D3,F | YES | |
| A | PHOENIX STEEL CORPORATION<br>PHOENIXVILLE | PA | 19460 | G1,G2,G4 | YES | |
| 0656 | PICKANDS MATHER AND COMPANY<br>CLEVELAND | OH | 44114 | | NO | |
| A | MILWAUKEE SOLVAY COKE COMPANY<br>MILWAUKEE | WI | 53204 | A | YES | |
| 0660 | PIPER INDUSTRIES, INC.<br>MEMPHIS | TN | 38113 | | NO | |
| A | PIPER INDUSTRIES, INC.<br>ST. LOUIS | MO | 63155 | | NO | |
| B | PIPER INDUSTRIES, INC.<br>GREENVILLE | MS | 38701 | | NO | |
| 0664 | PITTSBURGH TUBE COMPANY<br>MONACA | PA | 15061 | | NO | |
| A | PITTSBURGH INTERNATIONAL CORPORATION<br>FAIRBURY | IL | 61739 | | NO | |
| 0668 | PORTEC, INC.<br>OAK BROOK | IL | 60521 | | NO | |
| A | TROY PLANT<br>TROY | NY | 12180 | | NO | |
| B | FORGINGS DIVISION<br>CANTON | OH | 44701 | | NO | |
| C | MEMPHIS PLANT<br>MEMPHIS | TN | 38128 | | NO | |
| 0672 | CONNORS STEEL COMPANY<br>BIRMINGHAM | AL | 35212 | | NO | |
| A | CONNERS STEEL DIVISION<br>BIRMINGHAM | AL | 35212 | D3,F,G2 | YES | |
| B | WEST VIRGINIA WORKS<br>HUNTINGTON | WV | 25706 | D3,F,G1,G2 | YES | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME | CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0674 | PLYMOUTH TUBE COMPANY | WINFIELD | IL | 60190 |  | YES | FORMERLY 0884 |
| A | ELLWOOD IVINS PLANT | HORSHAM | PA | 19044 |  | NO | FORMERLY 0884A |
| B | PLYMOUTH TUBE DIVISION | WINFIELD | IL | 60190 |  | NO | FORMERLY 0884B |
| C | WINAMAC PLANT | WINAMAC | IN | 46996 | G4,I1 | YES | FORMERLY 0884C |
| D | STREATOR PLANT | STREATOR | IL | 61364 | I1 | YES | FORMERLY 0884D |
| E | PLYMOUTH TUBE DIVISION | DUNKIRK | NY | 14048 | G4,I3 | YES | FORMERLY 0884E |
| F | PLYMOUTH TUBE DIVISION | HORSHAM | PA | 19044 | I3 | YES | FORMERLY 0884F |
| G | BIRMINGHAM PLANT | PINSON | AL | 35126 | I1 | YES | FORMERLY 0884G |
| H | WEST MONROE PLANT | WEST MONROE | LA | 71291 | G4 | YES | FORMERLY 0884H |
| 0676 | PREDCO, INC. | PENNSAUKEN | NJ | 08110 |  | NO |  |
| A | PRECISION STEEL DIVISION | PENNSAUKEN | NJ | 08110 |  | NO |  |
| B | SOUTHERN PRECISION STEEL COMPANY | GULFPORT | MS | 39501 |  | NO |  |
| C | COMPRESSED STEEL SHAFTING COMPANY, INC. | READVILLE | MA | 02136 |  | NO |  |
| 0678 | QUANEX COPORATION | HOUSTON | TX | 77056 | G4 | NO | FORMERLY 0548 |
| A | GULF STATES TUBE CORPORATION DIVISION | ROSENBERG | TX | 77471 | G4,I3,K | YES | FORMERLY 0548A |
| B | THE STANDARD TUBE COMPANY | DETROIT | MI | 48239 | G4,I1,I3,K | NO | FORMERLY 0548B |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0678 C | THE STANDARD TUBE COMPANY<br>SHELBY | OH | 44875 | G4 | YES | FORMERLY 0548C |
| D | MAC STEEL COMPANY, DIVISION<br>JACKSON | MI | 48201 | D3,F | NO | FORMERLY 0548D |
| E | U.S. BROACH AND MACHINE COMPANY<br>DETROIT | MI | 48234 | | NO | FORMERLY 0548E |
| 0680 | RAMCO STEEL, INC.<br>BUFFALO | NY | 14240 | | NO | |
| 0684 | REPUBLIC STEEL<br>CLEVELAND | OH | 44101 | | YES | |
| * | YOUNGSTOWN MANUFACTURING<br>YOUNGSTOWN | OH | 44545 | K | YES | |
| A | YOUNGSTOWN WORKS<br>YOUNGSTOWN | OH | 44501 | A,C,G1,G2,J2,L1 | YES | |
| B | WARREN WORKS<br>WARREN | OH | 44181 | A,B,C,D1,G1,G3,I2,J1,L1,L2 | YES | |
| C | NILES WORKS<br>NILES | OH | 44446 | I1,J1,K | YES | SHUTDOWN |
| D | MASSILLON WORKS<br>MASSILLON | OH | 44646 | A,G1,G2,I1,I3,J1 | YES | |
| E | CANTON SOUTH WORKS<br>CANTON | OH | 44706 | D3,E,F,G1,G2,I1 | YES | |
| F | CLEVELAND DISTRICT WORKS<br>CLEVELAND | OH | 44127 | A,C,D1,D2,G1,G2,G3,I2,J1 | YES | |
| G | BUFFALO WORKS<br>BUFFALO | NY | 14220 | C,D1,G1,G2,I1 | YES | |
| H | CHICAGO DISTRICT WORKS<br>CHICAGO | IL | 60617 | A,C,D2,D3,E,G1,G2,G4,I1 | YES | |
| I | SOUTHERN DISTRICT<br>GADSDEN | AL | 35901 | A,B,C,D1,G1,G3,I2,J1,L1 | YES | |
| J | THOMAS WORKS<br>BIRMINGHAM | AL | 35202 | A | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0684 | K | STEEL AND TUBE DIVISION<br>CLEVELAND | OH | 44108 | I2,I3,J2 | YES | |
| | L | STEEL AND TUBE DIVISION<br>ELYRIA | OH | 44035 | G4 | YES | |
| | M | STEEL AND TUBE DIVISION<br>FERNDALE | MI | 48220 | G4 | YES | |
| | N | STEEL AND TUBE DIVISION<br>BROOKLYN | NY | 11237 | G4,I1 | YES | |
| | O | STEEL AND TUBE DIVISION<br>COUNCE | TN | 38326 | G4 | YES | |
| | P | UNION DRAWN DIVISION<br>MASSILLON | OH | 44646 | I1,I3 | YES | |
| | Q | UNION DRAWN DIVISION<br>BEAVER FALLS | PA | 15010 | I1 | YES | |
| | R | UNION DRAWN DIVISION<br>GARY | IN | 46401 | | NO | |
| | S | UNION DRAWN DIVISION<br>EAST HARTFORD | CT | 06108 | | NO | |
| | T | UNION DRAWN DIVISION<br>LOS ANGELES | CA | 90052 | | NO | |
| | U | A. FINKE AND SONS COMPANY<br>CHICAGO | IL | 60614 | D3,E | YES | |
| | V | CANTON WORKS<br>CANTON | OH | 44706 | G3,H,I1,I3 | YES | |
| | W | GEORGIA TUBING<br>CEDAR SPRINGS | GA | 31732 | G4 | YES | |
| | X | INDUSTRIAL PRODUCTS DIVISION<br>CANTON | OH | 44705 | K | YES | |
| | Y | DRAINAGE PRODUCTS DIVISION<br>CANTON | OH | 44705 | I1,K,L1 | YES | |
| | Z | NILES DOOR PLANT<br>NILES | OH | 44446 | K | YES | |

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0688 | | REVERE COPPER AND BRASS, INC.<br>NEW YORK | NY | 10016 | | NO | |
| | A | ROME MANUFACTURING COMPANY DIVISION<br>ROME | NY | 13440 | | NO | |
| 0692 | | RMI COMPANY<br>NILES | OH | 44446 | | NO | |
| | A | RMI COMPANY<br>ASHTABULA | OH | 44004 | | NO | |
| 0696 | | ROBLIN INDUSTRIES, INC.<br>BUFFALO | NY | 14202 | | NO | |
| | A | ROBLIN STEEL COMPANY<br>DUNKIRK | NY | 14048 | D3,E,F | YES | |
| | B | ROBLIN STEEL COMPANY<br>NORTH TONAWANDA | NY | 14120 | | NO | |
| 0700 | | ROME STRIP STEEL COMPANY<br>ROME | NY | 13440 | J1 | NO | |
| 0704 | | ROSS-MEEHAN FOUNDRIES<br>CHATTANOOGA | TN | 37401 | | NO | |
| 0708 | | ROSS STEEL WORKS, INC.<br>AMITE | LA | 70422 | | NO | |
| 0712 | | SANDVIK STEEL, INC.<br>FAIR LAWN | NJ | 07410 | | NO | |
| | A | SCRANTON WORKS<br>CLARKS SUMMIT | PA | 18501 | | NO | |
| | B | BENTON HARBOR WORKS<br>BENTON HARBOR | MI | 49022 | | NO | |
| 0716 | | SENECA STEEL SERVICE<br>BUFFALO | NY | 14217 | | NO | |
| 0720 | | SENECA WIRE AND MANUFACTURING COMPANY<br>FOSTORIA | OH | 44830 | | NO | |
| 0724 | | SHARON STEEL CORPORATION<br>SHARON | PA | 16146 | | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0724 | A | STEEL DIVISION<br>SHARON | PA | 16146 | C,D1,D3,E,H,I2,I3,J1,L1 | YES | |
| | B | UNION STEEL CORPORATION<br>UNION | PA | 07083 | | NO | |
| | C | DEARBORN DIVISION<br>DETROIT | MI | 48228 | | NO | |
| | D | BRAINARD STRAPPING DIVISION<br>WARREN | OH | 44482 | | NO | |
| | E | DAMASCUS TUBE DIVISION<br>GREENVILLE | PA | 16125 | | NO | |
| | F | FAIRMONT COKE WORKS<br>FAIRMONT | WV | 26554 | A | NO | SHUTDOWN |
| | G | CARPENTERTOWN COAL AND COKE COMPANY<br>TEMPLETON | PA | 16259 | | NO | |
| | H | MACOMBER, INC.<br>CANTON | OH | 44711 | | NO | |
| 0728 | | SHARON TUBE COMPANY<br>SHARON | PA | 16146 | G4,I1,K,L1 | YES | |
| 0732 | | SHENANGO, INC.<br>PITTSBURGH | PA | 15222 | | NO | |
| | A | NEVILLE ISLAND PLANT<br>PITTSBURGH | PA | 15225 | A,C | YES | |
| | B | BUFFALO PLANT<br>BUFFALO | NY | 14240 | | NO | |
| | C | SHARPSVILLE PLANT<br>SHARPSVILLE | PA | 16150 | | NO | |
| 0736 | | SIMONDS STEEL DIVISION OF WALLACE MURRAY<br>NEW YORK | NY | 10017 | D3 | YES | |
| 0740 | | SOULE STEEL COMPANY<br>SAN FRANCISCO | CA | 94124 | | NO | |
| | A | STEEL MILL OPERATIONS<br>CARSON | CA | 90745 | D3,F | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0744 | SOUTHERN FABRICATING COMPANY<br>SHEFFIELD | AL | 35660 | | NO | |
| A | DIXIE TUBE AND STEEL, INC.<br>DOTHAN | AL | 36301 | | NO | |
| 0748 | SOUTHWESTERN PIPE, INC.<br>HOUSTON | TX | 77001 | | NO | |
| A | SOUTHWESTERN PIPE, INC.<br>BOSSIER CITY | LA | 71010 | | NO | |
| 0752 | STANDARD FORGINGS CORPORATION<br>EAST CHICAGO | IN | 46312 | | NO | |
| 0756 | STANDARD STEEL SPECIALTY COMPANY<br>BEAVER FALLS | PA | 15010 | | NO | |
| A | SUPERIOR DRAWN STEEL COMPANY<br>MONACA | PA | 15061 | | NO | |
| 0760 | THE STANLEY STEEL DIVISION<br>NEW BRITAIN | CT | 06050 | I1,J1,K | YES | |
| A | THE STANLEY STEEL DIVISION<br>NEW BRITAIN | CT | 06053 | | NO | |
| 0764 | | | | | | SEE 0226 |
| A | | | | | | SEE 0226A |
| 0768 | STUPP BROTHERS BRIDGE AND IRON COMPANY<br>ST. LOUIS | MO | 63125 | | NO | |
| A | STUPP CORPORATION<br>BATON ROUGE | LA | 70821 | | NO | |
| B | MENGEL ROAD PLANT<br>BATON ROUGE | LA | 70821 | | NO | |
| C | THOMAS ROAD PLANT<br>BATON ROUGE | LA | 70821 | | NO | |
| 0772 | SUPERIOR TUBE COMPANY<br>NORRISTOWN | PA | 19404 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0776 | TELEDYNE VASCO<br>LATROBE | PA | 15650 | | YES | |
| A | TELEDYNE ALLVAC<br>MONROE | NC | 28110 | | NO | |
| B | TELEDYNE COLUMBIA-SUMMERILL<br>PITTSBURGH | PA | 15230 | | NO | |
| C | SCOTTDALE PLANT<br>SCOTTDALE | PA | 15683 | I3,K | NO | |
| D | CARNEGIE PLANT<br>CARNEGIE | PA | 15106 | I1,K | NO | |
| E | TELEDYNE OHIO STEEL COMPANY<br>LIMA | OH | 45802 | D3,E | NO | |
| F | TELEDYNE PITTSBURGH TOOL STEEL<br>MONACA | PA | 15061 | I3 | NO | |
| G | ROD AND WIRE DEPARTMENT<br>LATROBE | PA | 15650 | D3,G2,H,I3,K | YES | |
| H | COLONIAL PLANT<br>MONACA | PA | 15061 | G2,G3,H,I3 | YES | |
| I | TELEDYNE SURFACE ENGINEERING<br>PITTSBURGH | PA | 15206 | | NO | |
| J | TELEDYNE VASCO-CK COMPANY<br>SOUTH BOSTON | VA | 24592 | I3 | NO | |
| 0780 | TENNESSEE FORGING STEEL<br>ROANOKE | VA | 24015 | D3,F | YES | |
| A | NEWPORT DIVISION<br>NEWPORT | AR | 72112 | | NO | |
| B | JONES AND MCKNIGHT CORPORATION<br>CHICAGO | IL | 60623 | | NO | |
| C | KANKAKEE ELECTRICAL STEEL WORKS<br>KANKAKEE | IL | 60901 | | NO | |
| 0784 | TEXAS STEEL COMPANY<br>FT. WORTH | TX | 76110 | D3 | YES | |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0788 | THOMAS STEEL STRIP CORPORATION<br>WARREN | OH | 44485 | | NO | |
| 0792 | THOMPSON STEEL COMPANY, INC.<br>BRAINTREE | MA | 02184 | | NO | |
| A | THOMPSON STEEL COMPANY, INC.<br>WORCESTER | MA | 01603 | G2,I3,L1 | YES | |
| B | THOMPSON STEEL COMPANY, INC.<br>CHICAGO | IL | 60131 | I1,J1,L1 | YES | |
| C | THOMPSON STEEL COMPANY, INC.<br>SPARROWS POINT | MD | 21219 | I1,J1 | YES | |
| 0796 | THE TIMKEN COMPANY<br>CANTON | OH | 44706 | | YES | |
| A | GAMBRINUS PLANT<br>CANTON | OH | 44706 | D3,E,F,G1,G2,G4,I1,I3,K | YES | |
| B | WOOSTER PLANT<br>WOOSTER | OH | 44691 | G4,I1 | YES | |
| C | LATROBE STEEL COMPANY<br>LATROBE | PA | 15650 | D3,E | YES | |
| 0800 | TIPPINS MACHINERY COMPANY, INC.<br>ETNA | PA | 15223 | | NO | |
| A | TIPPINS MACHINERY COMPANY, INC.<br>LAWRENCEVILLE | PA | 15201 | | NO | |
| 0804 | TITANIUM METALS CORPORATION OF AMERICA<br>TORONTO | OH | 43964 | | NO | |
| A | STANDARD STEEL DIVISION<br>BURNHAM | PA | 17009 | D3,E | YES | |
| B | LATROBE FORGE AND SPRING<br>LATROBE | PA | 15650 | D3,E | YES | |
| 0808 | TOLEDO PICKLING AND STEEL SERVICE<br>TOLEDO | OH | 43607 | | NO | |
| 0810 | TONAWANDA COKE COMPANY<br>HARRIET | NY | 00240 | A | NO | FORMERLY 0024D |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0812 | | TONAWANDA IRON DIVISION<br>NORTH TONAWANDA | NY | 14120 | | NO | |
| 0816 | | TOWNSEND COMPANY<br>BEAVER FALLS | PA | 15010 | | NO | |
| | A | TOWNSEND PLANT<br>NEW BRIGHTON | PA | 15066 | | NO | |
| 0820 | | TREDEGAR COMPANY<br>RICHMOND | VA | 23211 | | NO | |
| 0824 | | TUBE METHODS, INC.<br>BRIDGEPORT | PA | 19405 | | NO | |
| 0828 | | TULL, J.M. INDUSTRIES, INC.<br>ATLANTA | GA | 30301 | | NO | |
| | A | TAMPCO DIVISION<br>NORCROSS | GA | 30091 | | NO | |
| 0832 | | ULBRICH STAINLESS & SPECIALTY METALS<br>WALLINGFORD | CN | 06492 | | NO | |
| 0836 | | UNARCO-LEAVITT TUBE DIVISION<br>CHICAGO | IL | 60643 | | NO | |
| 0840 | | UNION ELECTRIC STEEL CORPORATION<br>PITTSBURGH | PA | 15106 | | YES | |
| | A | UNION ELECTRIC STEEL CORPORATION<br>CARNEGIE | PA | 15106 | | NO | |
| | B | HARMON CREEK<br>BURGETTSTOWN | PA | 15021 | D3,E | YES | |
| | C | HARMON CREEK<br>VALPARAISO | IN | 46383 | | NO | |
| 0844 | | UNION SPECIALTY STEEL CASTING CORP.<br>VERONA | PA | 15147 | | NO | |
| 0848 | | | | | | | SEE 0426 |
| 0852 | | UNITED STATES STEEL CORPORATION<br>PITTSBURGH | PA | 15230 | | YES | |

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0852 A | UNITED STATES STEEL CORPORATION<br>NEW YORK | NY | 10022 | | NO | |
| 0856 | UNITED STATES STEEL - EASTERN<br>PITTSBURGH | PA | 15219 | | NO | |
| A | CLAIRTON WORKS<br>CLAIRTON | PA | 15025 | A,C,G2 | YES | |
| B | EDGAR THOMSON WORKS<br>BRADDOCK | PA | 15104 | C | YES | |
| C | CHRISTY PARK<br>MCKEESPORT | PA | 15132 | G4 | YES | |
| D | IRVIN WORKS<br>DRAVOSBURG | PA | 15034 | G3,I1,J1,K,L1,L2 | YES | |
| E | VANDERGRIFT WORKS<br>VANDERGRIFT | PA | 15690 | G3,H,I1,I3,J1,K | YES | |
| F | FAIRLESS WORKS<br>FAIRLESS HILLS | PA | 19030 | A,B,C,D1,D3,E,F,G1,G2,G<br>3G4,I1,K2,J1,K,L1 | YES | |
| G | FAIRLESS WORKS<br>TRENTON | NJ | 08608 | | NO | |
| H | HOMESTEAD WORKS<br>HOMESTEAD | PA | 15120 | D2,E,G1,G2,G3,I3 | YES | |
| I | HOMESTEAD WORKS<br>HOMESTEAD | PA | 15120 | C | YES | |
| J | HOMESTEAD WORKS<br>HOMESTEAD | PA | 15120 | B | YES | |
| K | HOMESTEAD WORKS<br>HOMESTEAD | PA | 15120 | G2 | YES | |
| L | JOHNSTOWN PLANT<br>JOHNSTOWN | PA | 15902 | | NO | |
| M | CANTON PLANT<br>CANTON | OH | 44706 | | NO | |
| N | LORAIN PLANT<br>LORAIN | OH | 44055 | A,B,C,D1,G1,G2,I1,J2,K,<br>L1 | YES | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0856 | O | CENTRAL FURNACES PLANT<br>CLEVELAND | OH | 44115 | C | YES | SHUTDOWN |
| | P | CUYAHOGA PLANT<br>CUYAHOGA HEIGHTS | OH | 44125 | G2,G3,I1,I2,J1,L1 | YES | |
| | Q | NATIONAL PLANT<br>MCKEESPORT | PA | 15132 | B,C,G1,G2,I1,J2,K | YES | |
| | R | DUQUESNE PLANT<br>DUQUESNE | PA | 15110 | C,D1,D3,E,G1,G2,I1 | YES | |
| | S | NEW HAVEN WORKS<br>NEW HAVEN | CT | 06507 | I1,I2,L | YES | |
| | T | YOUNGSTOWN WORKS<br>YOUNGSTOWN | OH | 44509 | B,C,D2,G1,I1 | YES | SHUTDOWN |
| | U | MACDONALD WORKS<br>MACDONALD | OH | 44437 | G2,G3,I1 | YES | SHUTDOWN |
| 0860 | | UNITED STATES STEEL - CENTRAL<br>PITTSBURGH | PA | 15230 | | NO | |
| | A | DULUTH PLANT<br>DULUTH | MN | 55808 | A | YES | SHUTDOWN |
| | B | GARY WORKS<br>GARY | IN | 46401 | A,B,C,D1,D2,F,G1,G2 | YES | |
| | C | GARY TUBE WORKS<br>GARY | IN | 46401 | | NO | |
| | D | ELLWOOD PLANT<br>ELLWOOD CITY | PA | 16117 | | NO | |
| | F | JOLIET PLANT<br>JOLIET | IL | 60432 | G2,I1,I2,I3,L1 | YES | |
| | G | WAUKEGAN PLANT<br>WAUKEGAN | IL | 60085 | I1,L1 | YES | SHUTDOWN |
| | H | SOUTH WORKS<br>CHICAGO | IL | 60617 | B,C,D1,D3,E,F,G1,G2,G3 | YES | |
| 0864 | | UNITED STATES STEEL - WESTERN<br>PITTSBURGH | PA | 15230 | | NO | |

# IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0864 | A | GENEVA WORKS<br>PROVO | UT | 84601 | A,B,C,D2,G1,G2,G3,J2 | YES | |
| | B | PITTSBURGH WORKS<br>PITTSBURGH | CA | 94546 | G2,I1,I2,J1,K,L1 | YES | |
| | C | TORRANCE WORKS<br>TORRANCE | CA | 90501 | D2,F,G1,G2 | YES | SHUTDOWN |
| 0868 | | UNITED STATES STEEL - SOUTHERN<br>PITTSBURGH | PA | 15230 | | NO | |
| | A | FAIRFIELD WORKS<br>FAIRFIELD | AL | 35064 | A,B,C,D1,G1,G2,I1,I2,J1<br>K,L1 | YES | |
| | B | TEXAS WORKS<br>BAYTOWN | TX | 77520 | D3,E,F,G3,J2 | YES | |
| | C | AMERICAN BRIDGE DIVISION<br>ORANGE | TX | 77630 | | NO | |
| 0872 | | VALLEY MOULD AND IRON<br>HUBBARD | OH | 44425 | | NO | |
| | A | CHICAGO PLANT<br>CHICAGO | IL | 60617 | | NO | |
| | B | CLEVELAND PLANT<br>CLEVELAND | OH | 44105 | | NO | |
| 0876 | | VALMONT INDUSTRIES, INC.<br>VALLEY | NB | 68064 | | NO | |
| 0880 | | VAN DORN HEAT TREATING COMPANY<br>CLEVELAND | OH | 44101 | | NO | |
| | A | HEAT TREATING DIVISION<br>MCKEES ROCKS | PA | 15136 | | NO | |
| 0884 | | | | | | | SEE 0674 |
| | A | | | | | | SEE 0674A |
| | B | | | | | | SEE 0674B |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|
| 0884 C | | | | | | SEE 0674C |
| D | | | | | | SEE 0674D |
| E | | | | | | SEE 0674E |
| F | | | | | | SEE 0674F |
| G | | | | | | SEE 0674G |
| H | | | | | | SEE 0674H |
| 0888 | VULCAN, INC.<br>LATROBE | PA | 15650 | | NO | |
| A | VULCAN MOULD AND IRON COMPANY<br>LATROBE | PA | 15650 | | NO | |
| B | VULCAN MOULD AND IRON COMPANY<br>LANSING | IL | 60438 | | NO | |
| C | VULCAN MOULD AND IRON COMPANY<br>TRENTON | MI | 48183 | | NO | |
| 0892 | WALKER MANUFACTURING COMPANY<br>RACINE | WI | 53402 | | NO | |
| A | ABERDEEN PLANT<br>ABERDEEN | MS | 39730 | | NO | |
| B | ARDEN PLANT<br>ARDEN | NC | 28704 | | NO | |
| C | GREENVILLE PLANT<br>GREENVILLE | TX | 75401 | | NO | |
| D | HARRISONBURG PLANT<br>HARRISONBURG | VA | 22801 | | NO | |
| E | JACKSON PLANT<br>JACKSON | MI | 49201 | | NO | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0892 | F | NEWARK PLANT<br>NEWARK | OH | 43055 | | NO | |
| | G | SEWARD PLANT<br>SEWARD | NB | 58434 | | NO | |
| 0894 | | WALKER STEEL AND WIRE COMPANY<br>FERNDALE | MI | | | NO | |
| 0896 | | WASHBURN WIRE COMPANY<br>EAST PROVIDENCE | RI | 02916 | D3,E | YES | |
| | A | WASHBURN WIRE COMPANY<br>NEW YORK | NY | 10035 | | NO | |
| 0900 | | WASHINGTON STEEL CORPORATION<br>WASHINGTON | PA | 15301 | | YES | |
| | A | FITCH WORKS<br>HOUSTON | PA | 15342 | D3 | YES | |
| | B | CALSTRIP STEEL COMPANY<br>LOS ANGELES | CA | 90022 | | NO | |
| 0904 | | WELDED TUBES, INC.<br>ORWELL | OH | 44076 | | NO | |
| 0908 | | WELDED TUBE COMPANY OF AMERICA<br>PHILADELPHIA | PA | 19148 | J2 | YES | |
| | A | WELDED TUBE COMPANY OF AMERICA<br>CHICAGO | IL | 60633 | J2 | YES | |
| 0912 | | WESTERN COLD DRAWN STEEL DIVISION<br>ELYRIA | OH | 44035 | | NO | |
| | A | WESTERN COLD DRAWN STEEL DIVISION<br>GARY | IN | 46401 | | NO | |
| 0916 | | WHEATLAND TUBE COMPANY<br>PHILADELPHIA | PA | 19106 | | NO | |
| | A | WHEATLAND STEEL PRODUCTS<br>WHEATLAND | PA | 16161 | G4,I1,K,L1 | YES | |
| 0920 | | WHEELING-PITTSBURGH STEEL CORPORATION<br>PITTSBURGH | PA | 15230 | | YES | |

## IRON AND STEEL PLANT INVENTORY

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0920 | A | STEUBENVILLE NORTH PLANT<br>STEUBENVILLE | OH | 43952 | C,G1,I2,J1 | YES | |
| | B | MONESSEN PLANT<br>MONESSEN | PA | 15062 | A,B,C,D1,G1,G2 | YES | |
| | C | ALLENPORT PLANT<br>ALLENPORT | PA | 15412 | G3,G4,I2,J1 | YES | |
| | D | BENWOOD PLANT<br>BENWOOD | WV | 26031 | I1,J2,L1 | YES | |
| | E | MARTINS FERRY PLANT<br>MARTINS FERRY | OH | 43935 | L1 | YES | |
| | F | STEUBENVILLE EAST PLANT<br>FOLLANSBEE | WV | 26037 | A,B,L2 | YES | |
| | G | YORKVILLE PLANT<br>YORKVILLE | OH | 43971 | I2,J1,K | YES | |
| | H | | | | | | SEE 0430 |
| | I | | | | | | SEE 0430A |
| | J | | | | | | SEE 0430B |
| | K | WHEELING CORRUGATION COMPANY<br>WHEELING | WV | 26003 | | NO | |
| | L | BEECH BOTTOM PLANT<br>BEECH BOTTOM | WV | 26030 | K | YES | |
| | M | LABELLE PLANT<br>WHEELING | WV | 26003 | | NO | |
| | N | STEUBENVILLE SOUTH PLANT<br>MINGO JUNCTION | OH | 43938 | C,D1,G1,G3 | YES | |
| | O | CANFIELD PLANT<br>CANFIELD | OH | 44406 | K | YES | |
| 0924 | | WHITTAKER CORPORATION<br>DETROIT | MI | 48234 | | NO | |

| PLANT CODE | | COMPANY / PLANT NAME<br>CITY | STATE | ZIP CODE | SUBCATEGORIES | DCP RSP | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0924 | A | WHITTAKER STRIP STEEL DIVISION<br>DETROIT | MI | 48234 | | NO | |
| 0928 | | WILSON STEEL AND WIRE COMPANY<br>CHICAGO | IL | 60609 | | NO | |
| 0932 | | WIRE ROPE CORPORATION OF AMERICA<br>ST. JOSEPH | MO | 64502 | | NO | |
| 0936 | | WIRE SALES COMPANY<br>CHICAGO | IL | 60632 | | NO | |
| 0940 | | WITTEMAN STEEL MILLS<br>FONTANA | CA | 92335 | D3,G1 | NO | |
| 0944 | | WRIGHT STEEL AND WIRE COMPANY<br>WORCESTER | MA | 01603 | | NO | |
| 0946 | | WSC CORPORATION<br>CHICAGO | IL | 60617 | | NO | FORMERLY 0400 |
| | A | WISCONSIN STEEL WORKS<br>CHICAGO | IL | 60617 | A,B,C,D1,E,F,G1,G2,G3 | YES | SHUTDOWN<br>FORMERLY 0400A |
| 0948 | | YOUNGSTOWN SHEET AND TUBE COMPANY<br>YOUNGSTOWN | OH | 44501 | | YES | |
| | A | CAMPBELL WORKS<br>STRUTHERS | OH | 44471 | A,B,C,D2,G1,G3,G4,I1,I2<br>J1,L1 | YES | |
| | B | BRIER HILL WORKS<br>YOUNGSTOWN | OH | 44510 | C,D2,G1,G2,I1,J2 | YES | |
| | C | INDIANA HARBOR WORKS<br>EAST CHICAGO | IN | 46312 | A,B,C,D1,D2,G1,G3,G4,I1<br>J1,L1 | YES | |
| | D | VAN HUFFEL TUBE CORPORATION<br>WAREN | OH | 44481 | | NO | |
| | E | VAN HUFFEL TUBE CORPORATION<br>GARDNER | MA | 01440 | | NO | |
| | F | CAMPBELL WORKS-STRUTHERS DIVISION<br>STRUTHERS | OH | 44471 | G2,I3,K | YES | SHUTDOWN |

## DEFINITION OF SUBCATEGORY ABBREVIATIONS

A : BY-PRODUCT COKEMAKING
B : SINTERING
C : IRONMAKING
D1 : STEELMAKING, BASIC OXYGEN FURNACE
D2 : STEELMAKING, OPEN HEARTH FURNACE
D3 : STEELMAKING, ELECTRIC ARC FURNACE
E : VACUUM DEGASSING
F : CONTINUOUS CASTING
G1 : HOT FORMING, PRIMARY
G2 : HOT FORMING, SECTION
G3 : HOT FORMING, FLAT
G4 : HOT FORMING, PIPE & TUBE
H : SALT BATH DESCALING
I1 : ACID PICKLING, SULFURIC
I2 : ACID PICKLING, HYDROCHLORIC
I3 : ACID PICKLING, COMBINATION
J1 : COLD FORMING, COLD ROLLING
J2 : COLD FORMING, PIPE & TUBE
K : ALKALINE CLEANING
L1 : HOT COATING, GALVANIZING
L2 : HOT COATING, TERNE & OTHER METALS

# VOLUME I

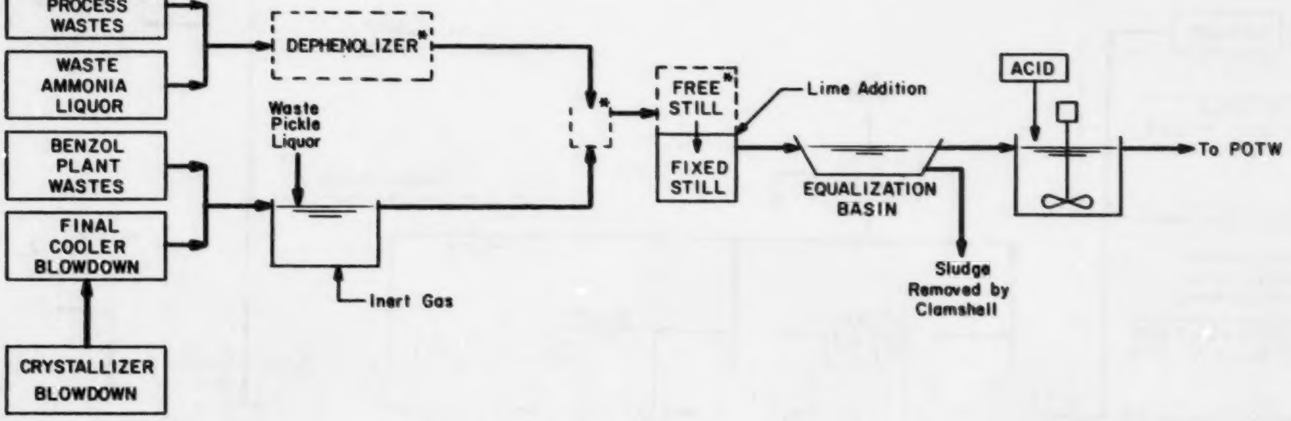
# APPENDIX C

# SUBCATEGORY SUMMARIES

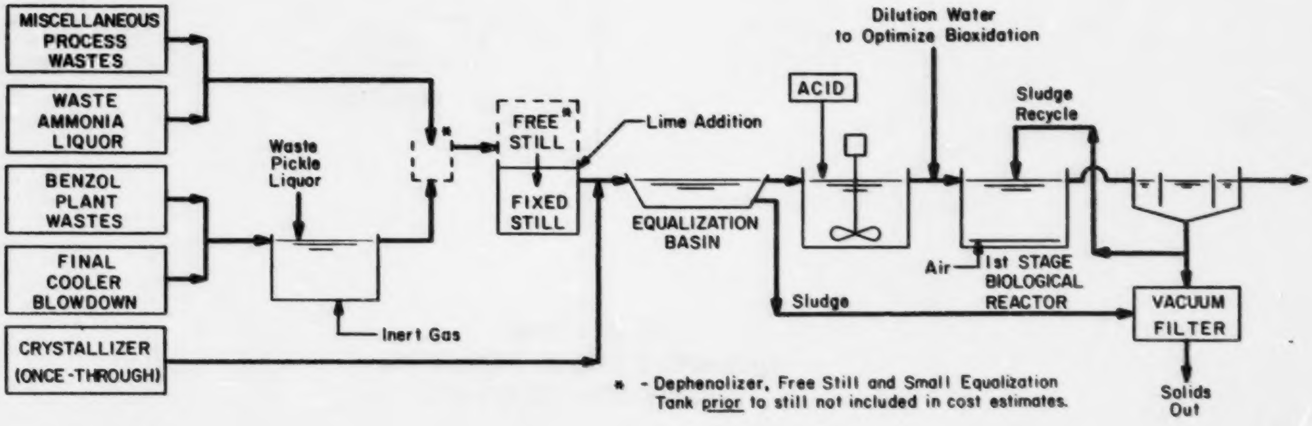
# BYPRODUCT COKEMAKING TREATMENT MODELS SUMMARY

(PAGE 1 OF 2)

PSES-1/ PSNS-1



BAT/BCT/PSES-2/PSNS-2



* - Dephenolizer, Free Still and Small Equalization Tank prior to still not included in cost estimates.

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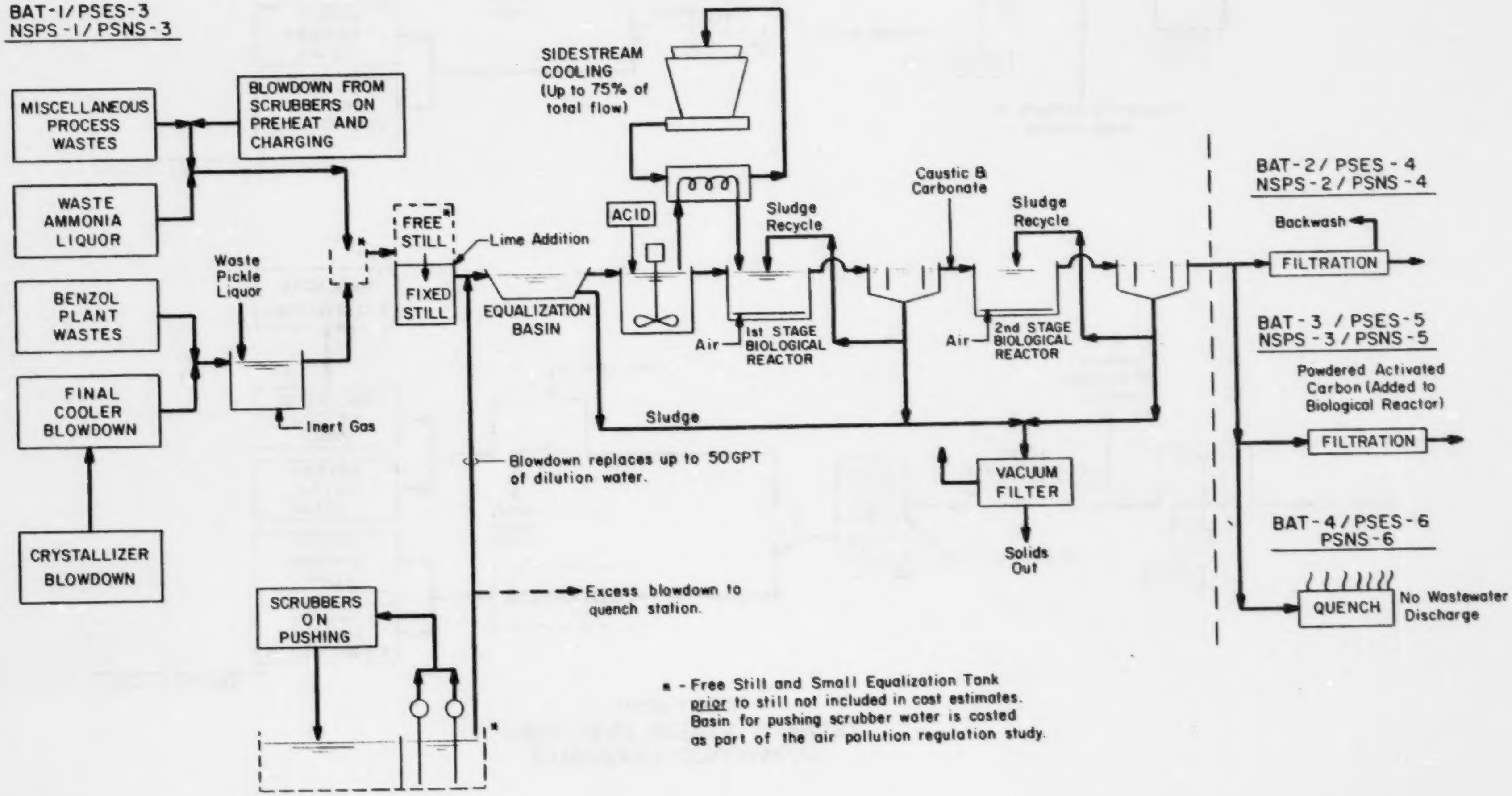
# BYPRODUCT COKEMAKING TREATMENT MODELS SUMMARY

(PAGE 2 OF 2)



* - Free Still and Small Equalization Tank *prior* to still not included in cost estimates. Basin for pushing scrubber water is costed as part of the air pollution regulation study.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: By-Product Cokemaking
: Iron and Steel Plants

MODEL SIZE (TPD): 4700
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model Plant | | 0.8 MGD |
| 15 | Direct Dischargers | 11.4 MGD |
| 13 | To Quenching Operations | 9.9 MGD |
| 8 | Indirect Dischargers | 6.1 MGD |
| 3 | Zero Dischargers | 0.8 MGD |
| 39 | Active Plants | 28.2 MGD |

| MODEL COSTS ($\$X10^{-3}$) | | PSES-1 | PSES-2 BPT | PSES-3 BAT-1 | PSES-4 BAT-2 | PSES-5 BAT-3 | PSES-6 BAT-4 |
|---|---|---|---|---|---|---|---|
| Investment | Biological | 4021 | 5232 | 1413 | 1927 | 1988 | 1672 |
| | Physical-Chemical | - | 4117 | 3716 | 4274 | - | 3919 |
| Annual | Biological | 1049 | 1379 | 327 | 398 | 623 | 359 |
| | Physical-Chemical | - | 1063 | 1557 | 1831 | - | 1583 |
| $/Ton of Production | Biological | 0.61 | 0.80 | 0.19 | 0.23 | 0.36 | 0.21 |
| | Physical-Chemical | - | 0.62 | 0.91 | 1.07 | - | 0.92 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | PSES-1 | PSES-2 BPT | PSES-3 BAT-1 | PSES-4 BAT-2 | PSES-5 BAT-3 | PSES-6 BAT-4$^{(5)}$ |
|---|---|---|---|---|---|---|---|---|
| | Flow (GPT) | 162 | 103 | $225^{(1)(2)}$ | $153^{(1)(3)}$ | $153^{(1)(4)}$ | $153^{(1)}$ | 0 |
| | pH (SU) | 7-10 | 6-9 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Ammonia-N | 600 | (75)60 | (97)75 | (15)7 | (15)7 | (10)5 | - |
| | Oil and Grease | 75 | (25)15 | (11.6)8 | (10)5 | (8)4 | (5)2 | - |
| | Phenolic Compounds (4-AAP) | 300 | (50)36 | (1.6)0.5 | (0.05)0.02 | (0.05)0.02 | (0.025)0.01 | - |
| | Sulfide | 150 | 50 | 1 | 0.4 | 0.4 | 0.3 | - |
| | Thiocyanate | 480 | 180 | 2 | 0.3 | 0.3 | 0.2 | - |
| | Total Suspended Solids | 50 | (120)100 | (80)66 | (80)66 | (20)15 | (20)15 | - |
| 3 | Acrylonitrile | 1.2 | 0.25 | 0.05 | 0.02 | 0.02 | 0.01 | - |
| 4 | Benzene* | 35 | 10 | 0.3 | (0.05)0.04 | (0.05)0.04 | (0.04)0.03 | - |
| 21 | 2,4,6,-Trichlorophenol | 0.1 | 0.05 | 0.02 | 0.005 | 0.005 | <0.005 | - |
| 22 | Parachlorometacresol | 0.6 | 0.15 | 0.05 | 0.005 | 0.005 | <0.005 | - |
| 23 | Chloroform* | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.05 | - |

SUBCATEGORY SUMMARY DATA
BY-PRODUCT COKEMAKING
PAGE 2

| | WASTEWATER CHARACTERISTICS | RAW WASTE | PSES-1 | PSES-2 BPT | PSES-3 BAT-1 | PSES-4 BAT-2 | PSES-5 BAT-3 | PSES-6 BAT-4 |
|---|---|---|---|---|---|---|---|---|
| 34 | 2,4-Dimethylphenol | 5 | 1 | 0.02 | 0.005 | 0.005 | <0.005 | - |
| 35 | 2,4-Dinitrotoluene | 0.2 | 0.1 | 0.02 | 0.01 | 0.01 | 0.005 | - |
| 36 | 2,6-Dinitrotoluene | 0.1 | 0.05 | 0.02 | 0.01 | 0.01 | 0.005 | - |
| 38 | Ethylbenzene* | 3 | 0.8 | 0.05 | 0.03 | 0.03 | 0.02 | - |
| 39 | Fluoranthene* | 0.8 | 0.2 | 0.05 | 0.02 | 0.02 | 0.01 | - |
| 54 | Isophorone | 0.5 | 0.3 | 0.1 | 0.01 | 0.01 | 0.005 | - |
| 55 | Naphthalene* | 30 | 5 | 0.05 | (0.01)0.005 | (0.01)0.005 | (0.01)<0.005 | - |
| 60 | 4,6-Dinitro-o-cresol | 0.12 | 0.08 | 0.01 | 0.005 | 0.005 | <0.005 | - |
| 64 | Pentachlorophenol | 0.12 | 0.08 | 0.01 | 0.005 | 0.005 | <0.005 | - |
| 65 | Phenol* | 275 | 30 | 0.3 | 0.005 | 0.005 | <0.005 | - |
| 66-71 | Total Phthalates* | 5 | 2 | 1 | 0.2 | 0.2 | 0.1 | - |
| 72 | Benzo (a) Anthracene | 0.3 | 0.2 | 0.05 | 0.01 | 0.01 | 0.005 | - |
| 73 | Benzo (a) Pyrene* | 0.1 | 0.05 | 0.05 | (0.02)0.01 | (0.02)0.01 | (0.01)0.005 | - |
| 76 | Chrysene* | 0.4 | 0.2 | 0.05 | 0.01 | 0.01 | 0.005 | - |
| 77 | Acenaphthylene* | 3.5 | 1.0 | 0.08 | 0.02 | 0.02 | 0.01 | - |
| 80 | Fluorene* | 0.6 | 0.2 | 0.05 | 0.02 | 0.02 | 0.01 | - |
| 84 | Pyrene* | 0.6 | 0.2 | 0.1 | 0.03 | 0.03 | 0.02 | - |
| 86 | Toluene* | 25 | 5 | 0.3 | 0.05 | 0.05 | 0.04 | - |
| 114 | Antimony* | 0.2 | 0.1 | 0.1 | 0.1 | 0.05 | 0.04 | - |
| 115 | Arsenic* | 2 | 1 | 0.4 | 0.4 | 0.25 | 0.25 | - |
| 121 | Cyanide* | 50 | (20)16 | (23)5 | (3)2.5 | (3)2.5 | (2.5)2 | - |
| 125 | Selenium* | 0.2 | 0.2 | 0.1 | 0.1 | 0.05 | 0.05 | - |
| 128 | Zinc* | 0.2 | 0.2 | 0.1 | 0.1 | 0.05 | 0.05 | - |
| 130 | Xylene* | 12 | 3 | 0.2 | 0.02 | 0.02 | 0.01 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-3 through PSES-6 costs are incremental over BPT/PSES-2 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples analyzed.

(1) Flow includes up to 50 GPT of dilution water to optimize conditions for bio-oxidation. Part of this dilution water may be replaced with blowdowns from air pollution control scrubbers from pushing operations.

(2) For physical-chemical plants, flow basis is 175 GPT, and limitations are as follows: Ammonia-N 125 mg/l; Oil & Grease 15 mg/l; Phenolic Compounds 2 mg/l; TSS 100 mg/l; and Cyanides 30 mg/l.

(3) For physical-chemical plants, flow basis is 103 GPT, and limitations are as follows: Ammonia-N 75 mg/l; Phenolic Compounds 0.1 mg/l Benzene 0.05 mg/l; Naphthalene 0.01 mg/l; and Benzo(a)pyrene 0.02 mg/l.

(4) For physical-chemical plants, flow basis is 103 GPT, and limitations are as follows: Ammonia-N 15 mg/l; Phenolic Compounds 0.05 mg/l; Benzene 0.05 mg/l; Naphthalene 0.01 mg/l; and Benzo(a)pyrene 0.02 mg/l.

(5) For physical-chemical plants, this alternative is BAT-3.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: By-Product Cokemaking
: Merchant Coke Producers

| | POTW USERS | ALL OTHERS |
|---|---|---|
| MODEL SIZE (TPD): | 920 | 1690 |
| OPER. DAYS/YEAR : | 365 | 365 |
| TURNS/DAY : | 3 | 3 |

### RAW WASTE FLOWS

| | | |
|---|---|---|
| | Model Plant | |
| | Indirect Discharger | 0.2 MGD |
| | All Others | 0.3 MGD |
| 7 | Direct Dischargers | 2.1 MGD |
| 2 | To Quenching Operations | 0.6 MGD |
| 8 | Indirect Dischargers | 1.3 MGD |
| 2 | Zero Dischargers | 0.3 MGD |
| 19 | Active Plants | 4.3 MGD |

| MODEL COSTS ($X10$^{-3}$) | PSES-1<br>PSNS-1 | BPT<br>BCT<br>PSES-2<br>PSNS-2 | BAT-1<br>PSES-3<br>PSNS-3 | BAT-2<br>PSES-4<br>PSNS-4 | BAT-3<br>PSES-5<br>PSNS-5 | BAT-4<br>PSES-6<br>PSNS-6 |
|---|---|---|---|---|---|---|
| Investment | | | | | | |
| Indirect Dischargers | 1658 | 2180 | 506 | 647 | 672 | 610 |
| Other Dischargers-Biological | - | 3097 | 721 | 924 | 959 | 870 |
| Other Dischargers-Physical-Chemical | - | 2455 | 2104 | 2435 | - | 2225 |
| Annual | | | | | | |
| Indirect Dischargers | 336 | 442 | 99.0 | 118 | 169 | 112 |
| Other Dischargers-Biological | - | 688 | 152 | 179 | 271 | 170 |
| Other Dischargers-Physical-Chemical | - | 538 | 907 | 1070 | - | 922 |
| $/Ton of Production | | | | | | |
| Indirect Dischargers | 1.00 | 1.32 | 0.29 | 0.35 | 0.50 | 0.33 |
| Other Dischargers-Biological | - | 1.12 | 0.25 | 0.29 | 0.44 | 0.28 |
| Other Dischargers-Physical-Chemical | - | 0.87 | 1.47 | 1.73 | - | 1.49 |

| | NSPS-1 | NSPS-2 | NSPS-3 |
|---|---|---|---|
| Investment | 3762 | 3965 | 4000 |
| Annual | 983 | 1010 | 1102 |
| $/Ton of Production | 1.59 | 1.64 | 1.79 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | PSES-1<br>PSNS-1 | BPT<br>BCT<br>PSES-2<br>PSNS-2 | BAT-1<br>NSPS-1<br>PSES-3<br>PSNS-3 | BAT-2<br>NSPS-2<br>PSES-4<br>PSNS-4 | BAT-3<br>NSPS-3<br>PSES-5<br>PSNS-5 | BAT-4<br>PSES-6<br>PSNS-6 |
|---|---|---|---|---|---|---|---|
| Flow (GPT) | 178 | 120 | 240 | 170 | 170 | 170 | 0 |
| pH (SU) | 7-10 | 6-9 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Ammonia-N | 600 | (75)60 | (97)75 | (25)7 | (25)7 | (20)5 | - |
| Oil and Grease | 75 | (25)15 | (11.6)8 | (5**)4.4 | (5**)4.4 | (5**)2.0 | - |
| Phenolic Compounds (4AAP) | 300 | (50)36 | (1.6)0.5 | (0.05)0.02 | (0.05)0.02 | (0.025)0.01 | - |
| Sulfides | 150 | 50 | 1 | 0.4 | 0.4 | 0.3 | - |
| Thiocyanates | 480 | 180 | 2 | 0.3 | 0.3 | 0.2 | - |
| Total Suspended Solids | 50 | (140)100 | (140)66 | (140)66 | (20)15 | (20)15 | - |

SUBCATEGORY SUMMARY DATA
BY-PRODUCT COKEMAKING
PAGE 2

| WASTEWATER CHARACTERISTICS | | RAW WASTE | PSES-1 PSNS-1 | BPT BCT PSES-2 PSNS-2 | BAT-1 NSPS-1 PSES-3 PSNS-3 | BAT-2 NSPS-2 PSES-4 PSNS-4 | BAT-3 NSPS-3 PSES-5 PSNS-5 | BAT-4 PSES-6 PSNS-6 |
|---|---|---|---|---|---|---|---|---|
| 3 | Acrylonitrile | 1.2 | 0.25 | 0.05 | 0.02 | 0.02 | 0.01 | - |
| 4 | Benzene* | 35 | 10 | 0.3 | (0.05)0.04 | (0.05)0.04 | (0.03)0.02 | - |
| 21 | 2,4,6-Trichlorophenol | 0.1 | 0.05 | 0.02 | 0.005 | 0.005 | <0.005 | - |
| 22 | Parachlorometacresol | 0.6 | 0.15 | 0.05 | 0.005 | 0.005 | <0.005 | - |
| 23 | Chloroform* | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.05 | - |
| 34 | 2,4-Dimethylphenol | 5 | 1 | 0.02 | 0.005 | 0.005 | <0.005 | - |
| 35 | 2,4-Dinitrotoluene | 0.2 | 0.1 | 0.02 | 0.01 | 0.01 | 0.005 | - |
| 36 | 2,6-Dinitrotoluene | 0.1 | 0.05 | 0.02 | 0.01 | 0.01 | 0.005 | - |
| 38 | Ethylbenzene* | 3 | 0.8 | 0.05 | 0.03 | 0.03 | 0.02 | - |
| 39 | Fluoranthene* | 0.8 | 0.2 | 0.05 | 0.02 | 0.02 | 0.01 | - |
| 54 | Isophorone | 0.5 | 0.3 | 0.1 | 0.01 | 0.01 | 0.005 | - |
| 55 | Naphthalene* | 30 | 5 | 0.05 | (0.05)0.005 | (0.05)0.005 | (0.03)<0.005 | - |
| 60 | 4,6-Dinitro-o-cresol | 0.12 | 0.08 | 0.01 | 0.005 | 0.005 | <0.005 | - |
| 64 | Pentachlorophenol | 0.12 | 0.08 | 0.01 | 0.005 | 0.005 | <0.005 | - |
| 65 | Phenol* | 275 | 30 | 0.3 | 0.005 | 0.005 | <0.005 | - |
| 66-71 | Total Phthalates* | 5 | 2 | 1 | 0.2 | 0.2 | 0.1 | - |
| 72 | Benzo (a) Anthracene | 0.3 | 0.2 | 0.05 | 0.01 | 0.01 | 0.005 | - |
| 73 | Benzo (a) Pyrene* | 0.1 | 0.05 | 0.05 | (0.05)0.01 | (0.05)0.01 | (0.03)0.005 | - |
| 76 | Chrysene* | 0.4 | 0.2 | 0.05 | 0.01 | 0.01 | 0.005 | - |
| 77 | Acenaphthylene* | 3.5 | 1 | 0.08 | 0.02 | 0.02 | 0.01 | - |
| 80 | Fluorene* | 0.6 | 0.2 | 0.05 | 0.02 | 0.02 | 0.01 | - |
| 84 | Pyrene* | 0.6 | 0.2 | 0.1 | 0.03 | 0.03 | 0.02 | - |
| 86 | Toluene* | 25 | 5 | 0.3 | 0.05 | 0.05 | 0.04 | - |
| 114 | Antimony* | 0.2 | 0.1 | 0.1 | 0.1 | 0.05 | 0.04 | - |
| 115 | Arsenic* | 2 | 1 | 0.4 | 0.4 | 0.25 | 0.25 | - |
| 121 | Cyanide* | 50 | (20)16 | (23)5 | (5.5)2.75 | (5.0)2.75 | (5.0)2 | - |
| 125 | Selenium* | 0.2 | 0.2 | 0.1 | 0.1 | 0.05 | 0.05 | - |
| 128 | Zinc* | 0.2 | 0.2 | 0.1 | 0.1 | 0.05 | 0.05 | - |
| 130 | Xylene* | 12 | 3 | 0.2 | 0.02 | 0.02 | 0.01 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-3 through PSES-6 and PSNS-3 through PSNS-6 costs are incremental over BPT, PSES-2 and PSNS-2 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## BY-PRODUCT COKEMAKING SUBCATEGORY

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 | BAT-4 |
|---|---|---|---|---|---|---|
| Flow (MGD) | 25.1 | 33.3 | 22.7 | 22.7 | 22.7 | 0 |
| Ammonia (N) | 22,947.7 | 3,796.8 | 242.0 | 242.0 | 172.9 | - |
| Oil and Grease | 2,868.5 | 404.9 | 152.1 | 152.1 | 69.2 | - |
| Phenolic Compounds (4AAP) | 11,473.9 | 25.3 | 0.6 | 0.6 | 0.3 | - |
| Sulfide | 5,736.9 | 50.7 | 13.8 | 13.8 | 10.4 | - |
| Thiocyanate | 18,358.3 | 101.2 | 10.4 | 10.4 | 6.9 | - |
| Total Cyanides | 1,912.2 | 253.1 | 95.0 | 86.4 | 69.2 | - |
| Total Suspended Solids | 1,912.2 | 3,846.2 | 2,623.5 | 518.7 | 518.7 | - |
| Total Toxic Metals | 99.5 | 35.4 | 24.2 | 13.8 | 13.5 | - |
| Total Organics(1) | 4,535.9 | 137.7 | 24.7 | 21.2 | 11.3 | - |
| **SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$)** | | | | | | |
| Investment | - | 168.6 | 44.1 | 62.0 | 64.2 | 54.6 |
| Annual | - | 41.61 | 11.49 | 14.22 | 20.71 | 12.77 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 | PSES-5 | PSES-6 |
|---|---|---|---|---|---|---|---|
| Flow (MGD) | 7.4 | 4.8 | 10.3 | 7.1 | 7.1 | 7.1 | 0 |
| Ammonia (N) | 6,759.1 | 434.4 | 1,167.3 | 74.6 | 74.6 | 53.3 | - |
| Oil and Grease | 844.9 | 108.6 | 124.5 | 46.9 | 46.9 | 21.3 | - |
| Phenolic Compounds (4AAP) | 3,379.5 | 260.6 | 7.7 | 0.2 | 0.2 | 0.1 | - |
| Sulfide | 1,689.8 | 361.9 | 15.6 | 4.3 | 4.3 | 3.2 | - |
| Thiocyanate | 5,407.2 | 1,303.0 | 31.2 | 3.2 | 3.2 | 2.2 | - |
| Total Cyanides | 563.3 | 115.8 | 77.8 | 29.3 | 26.7 | 21.3 | - |
| Total Suspended Solids | 563.3 | 723.9 | 1,182.3 | 809.8 | 159.9 | 159.9 | - |
| Total Toxic Metals | 29.3 | 10.8 | 10.9 | 7.4 | 4.3 | 4.1 | - |
| Total Organics(1) | 1,336.0 | 208.1 | 42.3 | 7.7 | 6.6 | 3.4 | - |
| **SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$)** | | | | | | | |
| Investment | - | 45.8 | 52.7 | 13.7 | 18.5 | 19.1 | 16.3 |
| Annual | - | 10.17 | 13.10 | 3.61 | 3.73 | 5.74 | 3.39 |

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(1) Individual phenolic compounds (e.g., 2,4-Dinitrophenol, Pentachlorophenol) are not included in Toxic Organics.

(2) Two confidential plants have been excluded from costs shown.

(3) The cost summary totals do not include one confidential plant.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## BY-PRODUCT COKEMAKING SUBCATEGORY
## IRON AND STEEL PLANTS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 | BAT-4 |
|---|---|---|---|---|---|---|
| Flow (MGD) | 22.1 | 29.6 | 20.1 | 20.1 | 20.1 | 0 |
| Ammonia (N) | 20,200.5 | 3,380.1 | 214.5 | 214.5 | 153.2 | - |
| Oil and Grease | 2,525.1 | 360.5 | 134.8 | 134.8 | 61.3 | - |
| Phenolic Compounds (4AAP) | 10,100.3 | 22.5 | 0.6 | 0.6 | 0.3 | - |
| Sulfide | 5,050.1 | 45.1 | 12.2 | 12.2 | 9.2 | - |
| Thiocyanate | 16,160.5 | 90.1 | 9.2 | 9.2 | 6.1 | - |
| Total Cyanides | 1,683.3 | 225.3 | 84.2 | 76.6 | 61.3 | - |
| Total Suspended Solids | 1,683.3 | 3,424.0 | 2,325.1 | 459.7 | 459.7 | - |
| Total Toxic Metals | 87.6 | 31.5 | 21.4 | 12.2 | 12.0 | - |
| Total Organics(1) | 3,992.9 | 122.6 | 21.9 | 18.8 | 10.0 | - |
| **SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$)** | | | | | | |
| Investment | | 144.0 | 37.2 | 53.0 | 54.9 | 46.2 |
| Annual | | 36.39 | 9.50 | 11.87 | 17.69 | 10.64 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 | PSES-5 | PSES-6 |
|---|---|---|---|---|---|---|---|
| Flow (MGD) | 6.1 | 3.9 | 8.5 | 5.8 | 5.8 | 5.8 | 0 |
| Ammonia (N) | 5,562.7 | 353.7 | 965.7 | 61.3 | 61.3 | 43.8 | - |
| Oil and Grease | 695.3 | 88.4 | 103.0 | 38.5 | 38.5 | 17.5 | - |
| Phenolic Compounds (4AAP) | 2,781.3 | 212.2 | 6.4 | 0.2 | 0.2 | 0.1 | - |
| Sulfide | 1,390.7 | 294.7 | 12.9 | 3.5 | 3.5 | 2.6 | - |
| Thiocyanate | 4,450.1 | 1,061.0 | 25.8 | 2.6 | 2.6 | 1.8 | - |
| Total Cyanides | 463.6 | 94.3 | 64.4 | 24.1 | 21.9 | 17.5 | - |
| Total Suspended Solids | 463.6 | 589.5 | 978.6 | 665.1 | 131.3 | 131.3 | - |
| Total Toxic Metals | 24.1 | 8.8 | 9.0 | 6.1 | 3.5 | 3.4 | - |
| Total Organics(1) | 1099.6 | 169.5 | 35.0 | 6.3 | 5.4 | 2.8 | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | | | |
| Investment | - | 35.7 | 39.7 | 10.7 | 14.6 | 15.1 | 12.7 |
| Annual | - | 8.17 | 10.46 | 2.48 | 3.02 | 4.73 | 2.73 |

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(1) Individual phenolic compounds (e.g., 2,4-Dinitrophenol, Pentachlorophenol) are not included in Toxic Organics.

(2) One confidential plant has been excluded from costs shown.

# SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
# BY-PRODUCT COKEMAKING SUBCATEGORY
# MERCHANT PLANTS

## DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 | BAT-4 |
|---|---|---|---|---|---|---|
| Flow (MGD) | 3.0 | 3.7 | 2.6 | 2.6 | 2.6 | 0 |
| Ammonia (N) | 2,747.2 | 416.7 | 27.5 | 27.5 | 19.7 | - |
| Oil and Grease | 343.4 | 44.4 | 17.3 | 17.3 | 7.9 | - |
| Phenolic Compounds (4AAP) | 1,373.6 | 2.8 | <0.1 | <0.1 | <0.05 | - |
| Sulfide | 686.8 | 5.6 | 1.6 | 1.6 | 1.2 | - |
| Thiocyanate | 2,197.8 | 11.1 | 1.2 | 1.2 | 0.8 | - |
| Total Cyanides | 228.9 | 27.8 | 10.8 | 9.8 | 7.9 | - |
| Total Suspended Solids | 228.9 | 422.2 | 298.4 | 59.0 | 59.0 | - |
| Total Toxic Metals | 11.9 | 3.9 | 2.8 | 1.6 | 1.5 | - |
| Total Organics(1) | 543.0 | 15.1 | 2.8 | 2.4 | 1.3 | - |
| SUBCATEGORY COST SUMMARY(2) ($\$X10^{-6}$) | | | | | | |
| Investment | - | 24.6 | 6.9 | 9.0 | 9.3 | 8.4 |
| Annual | - | 5.22 | 1.99 | 2.35 | 3.02 | 2.13 |

## INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 | PSES-5 | PSES-6 |
|---|---|---|---|---|---|---|---|
| Flow (MGD) | 1.3 | 0.9 | 1.8 | 1.3 | 1.3 | 1.3 | 0 |
| Ammonia (N) | 1,196.4 | 80.7 | 201.6 | 13.3 | 13.3 | 9.5 | - |
| Oil and Grease | 149.6 | 20.2 | 21.5 | 8.4 | 8.4 | 3.8 | - |
| Phenolic Compounds (4AAP) | 598.2 | 48.4 | 1.3 | <0.1 | <0.05 | <0.05 | - |
| Sulfide | 299.1 | 67.2 | 2.7 | 0.8 | 0.8 | 0.6 | - |
| Thiocyanate | 957.1 | 242.0 | 5.4 | 0.6 | 0.6 | 0.4 | - |
| Total Cyanides | 99.7 | 21.5 | 13.4 | 5.2 | 4.8 | 3.8 | - |
| Total Suspended Solids | 99.7 | 134.4 | 203.7 | 144.7 | 28.6 | 28.6 | - |
| Total Toxic Metals | 5.2 | 2.0 | 1.9 | 1.3 | 0.8 | 0.7 | - |
| Total Organics(1) | 236.4 | 38.6 | 7.3 | 1.4 | 1.2 | 0.6 | - |
| SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$) | | | | | | | |
| Investment | - | 10.1 | 13.0 | 3.0 | 3.9 | 4.0 | 3.6 |
| Annual | - | 2.00 | 2.64 | 0.59 | 0.71 | 1.01 | 0.66 |

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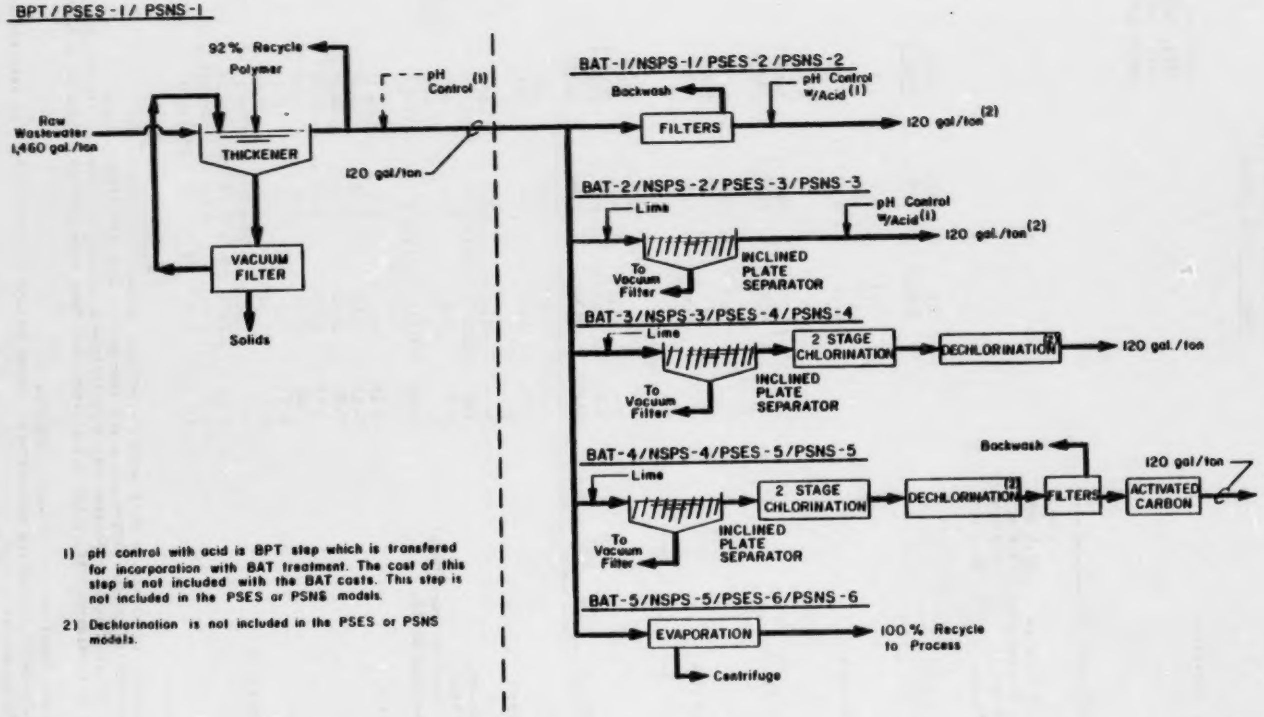
(1) Individual phenolic compounds (e.g., 2,4-Dinitrophenol, Pentachlorophenol) are not included in Toxic Organics.

(2) One confidential plant has been excluded from costs shown.

(3) The cost summary totals do not include confidential plants.

# SINTERING
# TREATMENT MODELS SUMMARY

BPT, BAT, PSES MODEL PLANT - 4,000 TPD
NSPS, PSNS MODEL PLANT - 7,000 TPD



1) pH control with acid is BPT step which is transfered for incorporation with BAT treatment. The cost of this step is not included with the BAT costs. This step is not included in the PSES or PSNS models.

2) Dechlorination is not included in the PSES or PSNS models.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sintering

BPT, BAT, PSES MODEL SIZE (TPD): 4000
NSPS, PSNS MODEL SIZE (TPD) : 7000
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 5.8 MGD |
| 15 Direct Dischargers | 87.6 MGD |
| 1 Indirect Discharger | 5.8 MGD |
| 1 Zero Discharger | 5.8 MGD |
| 17 Active Plants | 99.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 | BAT-4<br>PSES-5 | BAT-5<br>PSES-6 |
|---|---|---|---|---|---|---|
| Investment | 3615 | 401 | 316 | 647 | 3127 | 4936 |
| Annual | 1430 | 54.0 | 42.4 | 151 | 473 | 1016 |
| $/Ton of Production | 0.98 | 0.037 | 0.029 | 0.10 | 0.32 | 0.70 |

| MODEL COSTS ($X10$^{-3}$) | PSNS-1 | NSPS-1<br>PSNS-2 | NSPS-2<br>PSNS-3 | NSPS-3<br>PSNS-4 | NSPS-4<br>PSNS-5 | NSPS-5<br>PSNS-6 |
|---|---|---|---|---|---|---|
| Investment | 4822 | 5362 | 5219 | 5594 | 8524 | 11,459 |
| Annual | 2299 | 1399 | 1380 | 1462 | 1842 | 2799 |
| $/Ton of Production | 0.90 | 0.55 | 0.54 | 0.57 | 0.72 | 1.10 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-3<br>PSES-4<br>PSNS-4 | BAT-4<br>NSPS-4<br>PSES-5<br>PSNS-5 | BAT-5<br>NSPS-5<br>PSES-6<br>PSNS-6 |
|---|---|---|---|---|---|---|---|
| Flow (GPT) | 1460 | 120 | 120 | 120 | 120 | 120 | 0 |
| pH (SU) | 6-12 | 6-9 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Ammonia (N) | 6 | 7 | 7 | 7 | (10**)6 | (10**)6 | - |
| Fluoride | 6 | 25 | 20 | 20 | 20 | 20 | - |
| Oil and Grease | 240 | (10)7 | (5***)3.5 | (10)7 | (10)7 | (5***)3.5 | - |
| Phenols (4AAP) | 0.2 | 0.2 | 0.2 | 0.2 | (0.1**)0.015 | (0.1**)0.015 | - |
| Residual Chlorine (Max. Only) | - | - | - | - | (0.5**)0.05 | (0.5**)0.05 | - |
| Total Suspended Solids | 6100 | (50)39 | (15)10 | (25)22 | (25)22 | (15)10 | - |
| 39 Fluoranthene | 0.10 | 0.1 | 0.1 | 0.1 | 0.1 | 0.01 | - |
| 65 Phenol* | 0.03 | 0.05 | 0.05 | 0.05 | 0.01 | 0.01 | - |
| 76 Chrysene | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 84 Pyrene* | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 118 Cadmium* | 0.05 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 119 Chromium* | 0.7 | 0.6 | 0.2 | 0.15 | 0.15 | 0.15 | - |
| 120 Copper* | 0.1 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | - |
| 121 Cyanide (Total)* | 0.2 | 0.2 | 0.2 | 0.2 | (1**)0.03 | (1**)0.03 | - |
| 122 Lead | 0.15 | 0.12 | (0.25)0.02 | (0.25)0.02 | (0.25)0.02 | (0.25)0.02 | - |
| 124 Nickel* | 0.1 | 0.02 | 0.01 | 0.015 | 0.015 | 0.01 | - |
| 128 Zinc* | 1 | 0.5 | (0.3)0.18 | (0.3)0.04 | (0.3)0.06 | (0.3)0.01 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-6 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** When co-treated with ironmaking wastewaters. These values are based upon the selected BAT alternative in the Ironmaking Subcategory.
***Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## SINTERING SUBCATEGORY

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 | BAT-4 | BAT-5 |
|---|---|---|---|---|---|---|---|
| Flow (MGD) | 93.4 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 0 |
| Ammonia (N) | 853.8 | 65.8 | 65.8 | 65.8 | 65.8 | 65.8 | - |
| Cyanide (Total) | 28.5 | 2.2 | 2.2 | 2.2 | 0.3 | 0.3 | - |
| Fluoride | 853.8 | 274.1 | 219.3 | 219.3 | 219.3 | 219.3 | - |
| Oil and Grease | 34,153.3 | 76.8 | 38.4 | 76.8 | 76.8 | 38.4 | - |
| Phenols (4AAP) | 28.5 | 2.2 | 2.2 | 2.2 | 0.2 | 0.2 | - |
| Residual Chlorine | - | - | - | - | 0.5 | 0.5 | - |
| Total Suspended Solids | 868,064.2 | 427.6 | 109.7 | 241.2 | 241.2 | 109.7 | - |
| Total Toxic Metals | 298.8 | 14.0 | 4.8 | 2.8 | 2.8 | 2.4 | - |
| Total Organics(2) | 17.1 | 1.3 | 1.3 | 1.3 | 1.3 | 0.3 | - |
| **SUBCATEGORY COST SUMMARY ($X$10^{-6}$)** | | | | | | | |
| Investment | - | 63.89 | 6.02 | 4.98 | 10.33 | 47.86 | 74.80 |
| Annual | - | 22.00 | 0.79 | 0.64 | 2.29 | 7.15 | 15.40 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 | PSES-5 | PSES-6 |
|---|---|---|---|---|---|---|---|
| Flow (MGD) | 5.8 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0 |
| Ammonia (N) | 53.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | - |
| Cyanide (Total) | 1.8 | 0.1 | 0.1 | 0.1 | 0.02 | 0.02 | - |
| Fluoride | 53.4 | 18.3 | 14.6 | 14.6 | 14.6 | 14.6 | - |
| Oil and Grease | 2,134.6 | 5.1 | 2.6 | 5.1 | 5.1 | 2.6 | - |
| Phenols (4AAP) | 1.8 | 0.1 | 0.1 | 0.1 | 0.01 | 0.01 | - |
| Total Suspended Solids | 54,254.0 | 28.5 | 7.3 | 16.1 | 16.1 | 7.3 | - |
| Total Toxic Metals | 18.7 | 0.9 | 0.3 | 0.2 | 0.2 | 0.2 | - |
| Total Organics(2) | 1.1 | 0.09 | 0.09 | 0.09 | 0.09 | 0.02 | - |
| **SUBCATEGORY COST SUMMARY ($X$10^{-6}$)** | | | | | | | |
| Investment | - | 3.23 | 0.36 | 0.28 | 0.58 | 2.79 | 4.99 |
| Annual | - | 1.28 | 0.048 | 0.038 | 0.14 | 0.42 | 1.04 |

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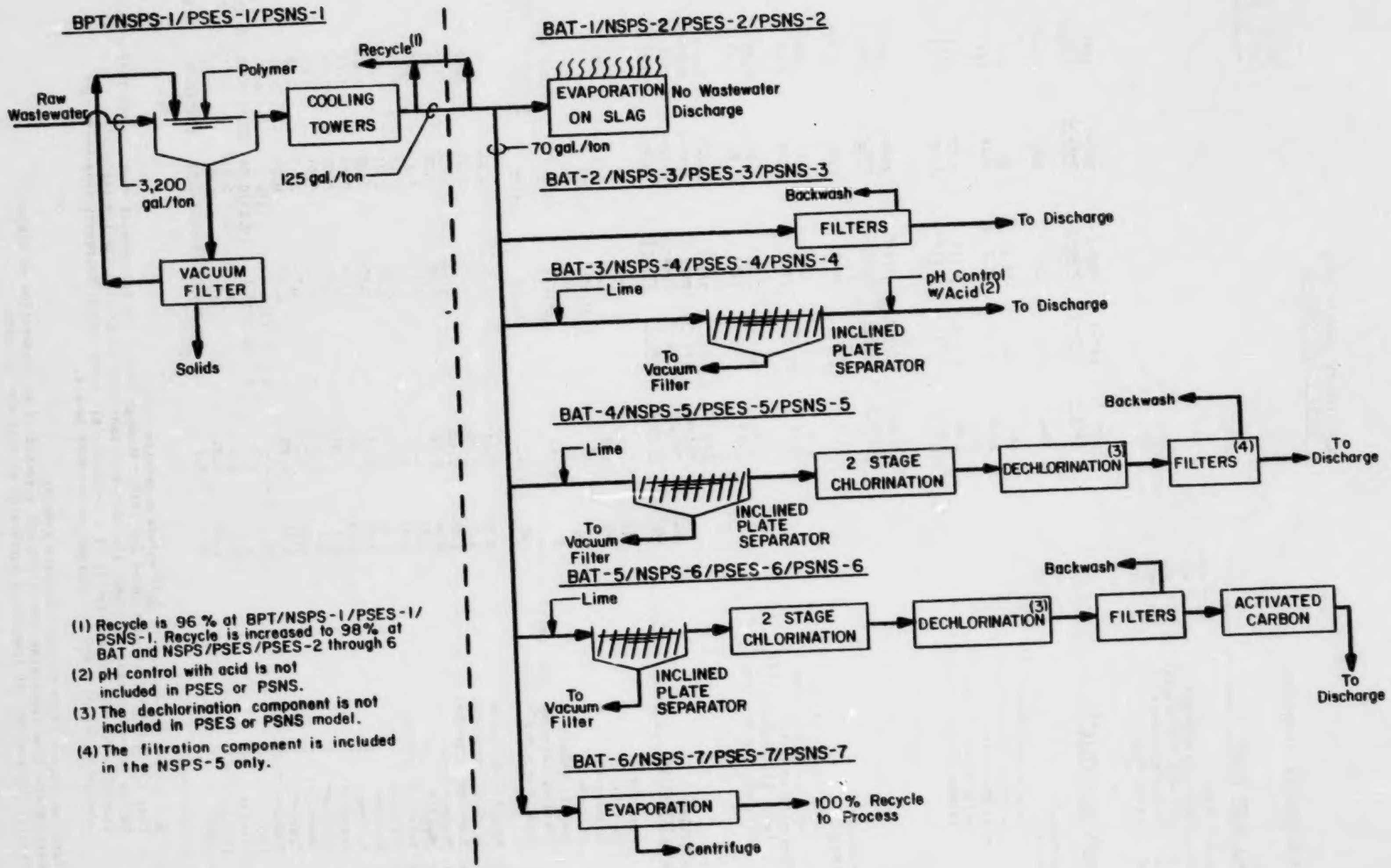
(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Individual phenolic compounds (e.g., 2,4-dinitrophenol, pentachlorophenol) are not included in total organics.

# IRONMAKING
# TREATMENT MODELS SUMMARY

## MODEL PLANT - 6000 TPD



(1) Recycle is 96% at BPT/NSPS-1/PSES-1/PSNS-1. Recycle is increased to 98% at BAT and NSPS/PSES/PSES-2 through 6

(2) pH control with acid is not included in PSES or PSNS.

(3) The dechlorination component is not included in PSES or PSNS model.

(4) The filtration component is included in the NSPS-5 only.

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## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Ironmaking

MODEL SIZE (TPD): 6000
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

RAW WASTE FLOWS

| | | |
|---|---|---|
| | Model Plant | 19.2 MGD |
| 39 | Direct Dischargers | 748.8 MGD |
| 2 | Indirect Dischargers | 38.4 MGD |
| 4 | Zero Dischargers(1) | 76.8 MGD |
| 45 | Active Plants | 864.0 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 | BAT-4<br>PSES-5 | BAT-5<br>PSES-6 | BAT-6<br>PSES-7 |
|---|---|---|---|---|---|---|---|
| Investment | 9542 | 172 | 286 | 384 | 784 | 3149 | 4408 |
| Annual | | | | | | | |
| (with Sinter Plant)(2) | 972 | 24.2 | 38.2 | 58.9 | 234 | 541 | 900 |
| (without Sinter Plant) | 2248 | 24.2 | 38.2 | 58.9 | 234 | 541 | 900 |
| $/Ton of Production | | | | | | | |
| (with Sinter Plant)(2) | 0.44 | 0.011 | 0.017 | 0.027 | 0.11 | 0.25 | 0.41 |
| (without Sinter Plant) | 1.03 | 0.011 | 0.017 | 0.027 | 0.11 | 0.25 | 0.41 |

| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 | NSPS-4<br>PSNS-4 | NSPS-5<br>PSNS-5 | NSPS-6<br>PSNS-6 | NSPS-7<br>PSNS-7 |
|---|---|---|---|---|---|---|---|
| Investment | 9542 | 9714 | 9828 | 9926 | 10,326 | 12,691 | 13,950 |
| Annual | | | | | | | |
| (with Sinter Plant)(2) | 972 | 996 | 1010 | 1031 | 1206 | 1512 | 1872 |
| (without Sinter Plant) | 2248 | 2272 | 2286 | 2306 | 2482 | 2788 | 3148 |
| $/Ton of Production | | | | | | | |
| (with Sinter Plant)(2) | 0.44 | 0.45 | 0.46 | 0.47 | 0.55 | 0.69 | 0.85 |
| (without Sinter Plant) | 1.03 | 1.04 | 1.04 | 1.05 | 1.13 | 1.27 | 1.44 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-4<br>PSES-4<br>PSNS-4 | BAT-4<br>NSPS-5<br>PSES-5<br>PSNS-5 | BAT-5<br>NSPS-6<br>PSES-6<br>PSNS-6 | BAT-6<br>NSPS-7<br>PSES-7<br>PSNS-7 |
|---|---|---|---|---|---|---|---|---|---|
| | Flow (GPT) | 3200 | 125 | 0 | 70 | 70 | 70 | 70 | 0 |
| | pH (SU) | 6-9 | 6-9 | - | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Ammonia (N) | 20 | (103)60 | - | (103)65 | (103)65 | (10)6 | (10)6 | - |
| | Fluoride | 15 | 45 | - | 40 | 20 | 20 | 20 | - |
| | Phenols (4AAP) | 3 | (4)2.3 | - | (4)2.3 | (4)2.3 | (0.1)0.015 | (0.1)0.015 | - |
| | Residual Chlorine (Max. Only) | - | - | - | - | - | (0.5)0.05 | (0.5)0.05 | - |
| | Total Suspended Solids | 1900 | (50)42 | - | (15)10 | (25)22 | (25)22 | (15)10 | - |
| 9 | Hexachlorobenzene | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 31 | 2,4-Dichlorophenol | 0.01 | 0.03 | - | 0.03 | 0.03 | 0.02 | 0.02 | - |
| 34 | 2,4-Dimethylphenol | 0.05 | 0.15 | - | 0.15 | 0.15 | 0.02 | 0.02 | - |
| 39 | Fluoranthene | 0.08 | 0.08 | - | 0.08 | 0.08 | 0.08 | 0.01 | - |
| 65 | Phenol* | 0.65 | 2.1 | - | 2.1 | 2.1 | 0.01 | 0.01 | - |
| 73 | Benzo (a) pyrene | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 76 | Chrysene | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 84 | Pyrene* | 0.05 | 0.05 | - | 0.05 | 0.05 | 0.05 | 0.01 | - |
| 114 | Antimony | 0.04 | 0.04 | - | 0.04 | 0.04 | 0.04 | 0.04 | - |
| 115 | Arsenic* | 0.1 | 0.05 | - | 0.05 | 0.05 | 0.05 | 0.05 | - |
| 118 | Cadmium* | 0.1 | 0.1 | - | 0.1 | 0.01 | 0.01 | 0.01 | - |
| 119 | Chromium* | 0.5 | 0.2 | - | 0.2 | 0.15 | 0.15 | 0.15 | - |
| 120 | Copper* | 0.25 | 0.03 | - | 0.03 | 0.02 | 0.02 | 0.02 | - |
| 121 | Cyanide (Total)* | 12 | (15)4 | - | (5)4 | (5)4 | (1)0.03 | (1)0.03 | - |
| 122 | Lead | 5 | 0.5 | - | (0.25)0.1 | (0.25)0.08 | (0.25)0.08 | (0.25)0.08 | - |
| 124 | Nickel* | 0.5 | 0.1 | - | 0.015 | 0.015 | 0.015 | 0.01 | - |
| 125 | Selenium | 0.06 | 0.01 | - | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 128 | Zinc* | 20 | 0.7 | - | (0.3)0.18 | (0.3)0.08 | (0.3)0.08 | (0.3)0.02 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: Cost for the BAT-1 through BAT-6 and PSES-2 through PSES-7 are incremental over the BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
(1) Wastewaters from ironmaking operations are disposed of by evaporation on slag.
(2) Credits for recovery of ironmaking wastewater sludges are included.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## IRONMAKING SUBCATEGORY

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 | BAT-4 | BAT-5 | BAT-6 |
|---|---|---|---|---|---|---|---|---|
| Flow (MGD) | 825.6 | 29.2 | 0 | 16.4 | 16.4 | 16.4 | 16.4 | 0 |
| Ammonia (N) | 25,147.2 | 2,672.8 | - | 1,621.5 | 1,621.5 | 149.7 | 149.7 | - |
| Cyanide (Total) | 15,088.3 | 178.2 | - | 99.8 | 99.8 | 0.7 | 0.7 | - |
| Fluoride | 18,860.4 | 2,004.6 | - | 997.8 | 498.9 | 498.9 | 498.9 | - |
| Phenols (4AAP) | 3,772.1 | 102.5 | - | 57.4 | 57.4 | 0.4 | 0.4 | - |
| Residual Chlorine | - | - | - | - | - | 1.2 | 1.2 | - |
| Total Suspended Solids | 2,388,979.8 | 1,871.0 | - | 249.5 | 548.8 | 548.8 | 249.5 | - |
| Total Toxic Metals | 33,382.8 | 77.1 | - | 18.1 | 11.4 | 11.4 | 9.7 | - |
| Total Organics(2) | 201.2 | 7.1 | - | 4.0 | 4.0 | 4.0 | 1.2 | - |
| **SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$)** | | | | | | | | |
| Investment | - | 434.74(4) | 7.28 | 11.28 | 14.80 | 30.84 | 123.09 | 171.64 |
| Annual | - | 55.27 | 1.02 | 1.49 | 2.26 | 9.04 | 21.03 | 35.06 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 | PSES-5 | PSES-6 | PSES-7 |
|---|---|---|---|---|---|---|---|---|
| Flow (MGD) | 38.4 | 1.5 | 0 | 0.8 | 0.8 | 0.8 | 0.8 | 0 |
| Ammonia (N) | 1,169.6 | 137.1 | - | 83.2 | 83.2 | 7.7 | 7.7 | - |
| Cyanide (Total) | 701.8 | 9.1 | - | 5.1 | 5.1 | 0.04 | 0.04 | - |
| Fluoride | 877.2 | 102.8 | - | 51.2 | 25.6 | 25.6 | 25.6 | - |
| Phenols (4AAP) | 175.4 | 5.3 | - | 2.9 | 2.9 | 0.02 | 0.02 | - |
| Total Suspended Solids | 111,115.3 | 95.9 | - | 12.8 | 28.1 | 28.1 | 12.8 | - |
| Total Toxic Metals | 1,552.7 | 4.0 | - | 0.9 | 0.6 | 0.6 | 0.5 | - |
| Total Organics(2) | 9.4 | 0.4 | - | 0.2 | 0.2 | 0.2 | 0.06 | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | | | | |
| Investment | - | 12.92(4) | 0.23 | 0.39 | 0.45 | 0.95 | 4.15 | 5.97 |
| Annual | - | 2.13 | 0.033 | 0.052 | 0.064 | 0.30 | 0.71 | 1.22 |

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(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharge, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Individual phenolic compounds (e.g., 2,4-dinitrophenol, pentachlorophenol) are not included in total organics.

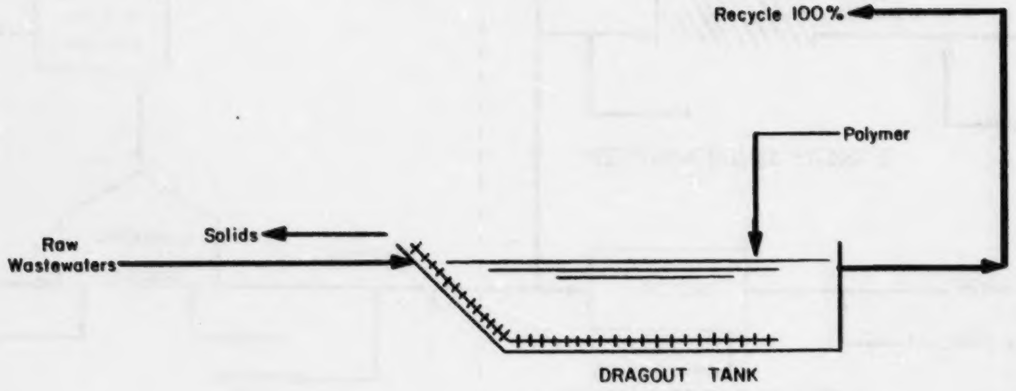
(3) The cost summary totals do not include confidential plants.

(4) A credit for recovery of sludges in sinter plants has been applied for those ironmaking operations which have sintering operations on-site or available for use.

## BASIC OXYGEN FURNACE - SEMI-WET TREATMENT MODELS SUMMARY

### MODEL PLANT - 5300 TPD

**BPT/BAT/BCT/PSES**



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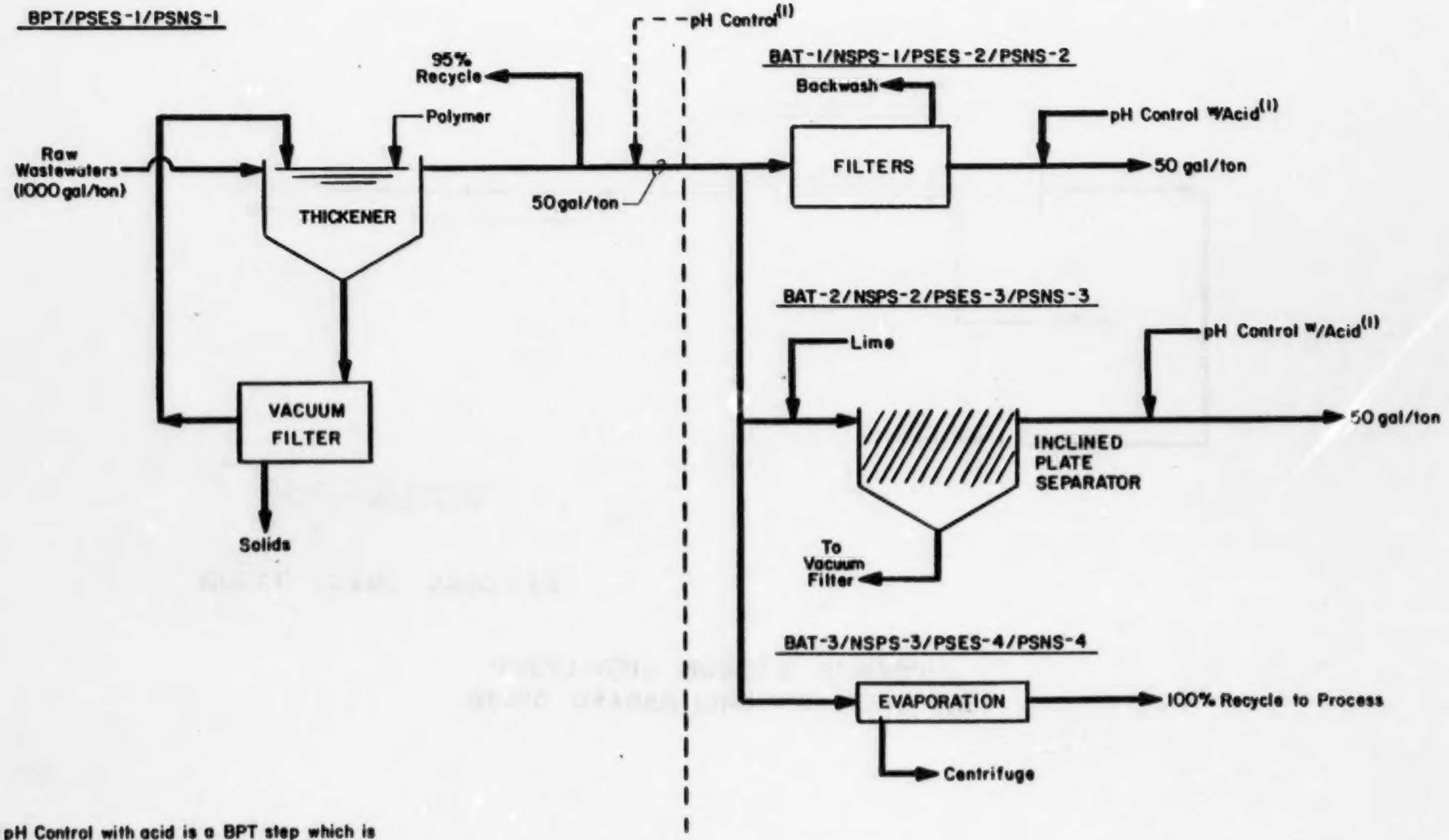
## BASIC OXYGEN FURNACE-WET-SUPPRESSED COMBUSTION
## TREATMENT MODELS SUMMARY

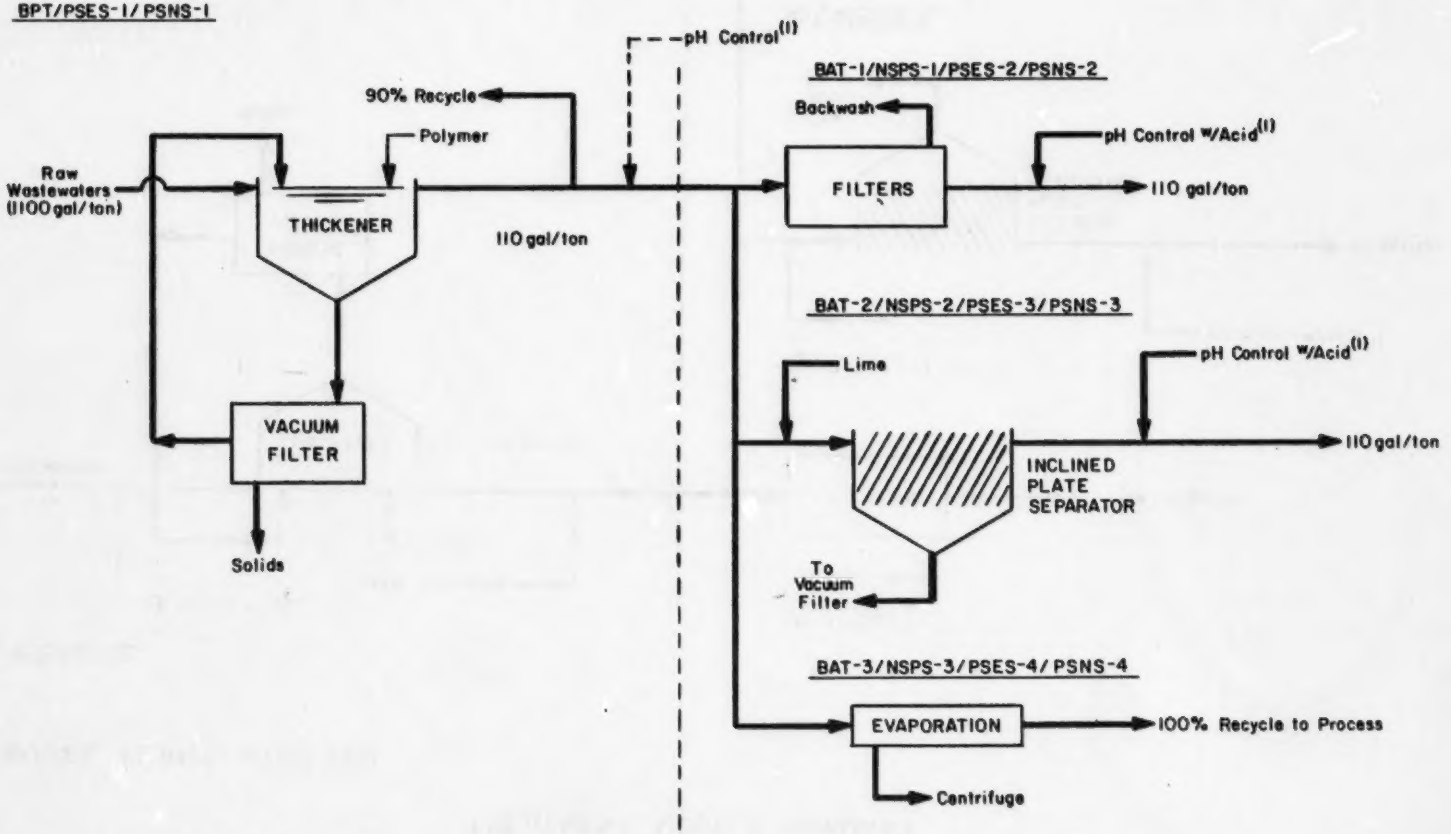
### MODEL PLANT-7400 TPD



(1) pH Control with acid is a BPT step which is transferred for incorporation with BAT treatment. The cost of this step is not included with the BAT costs, nor is it included in the PSES/PSNS models.

# BASIC OXYGEN FURNACE-WET-OPEN COMBUSTION TREATMENT MODELS SUMMARY

## MODEL PLANT-9100 TPD



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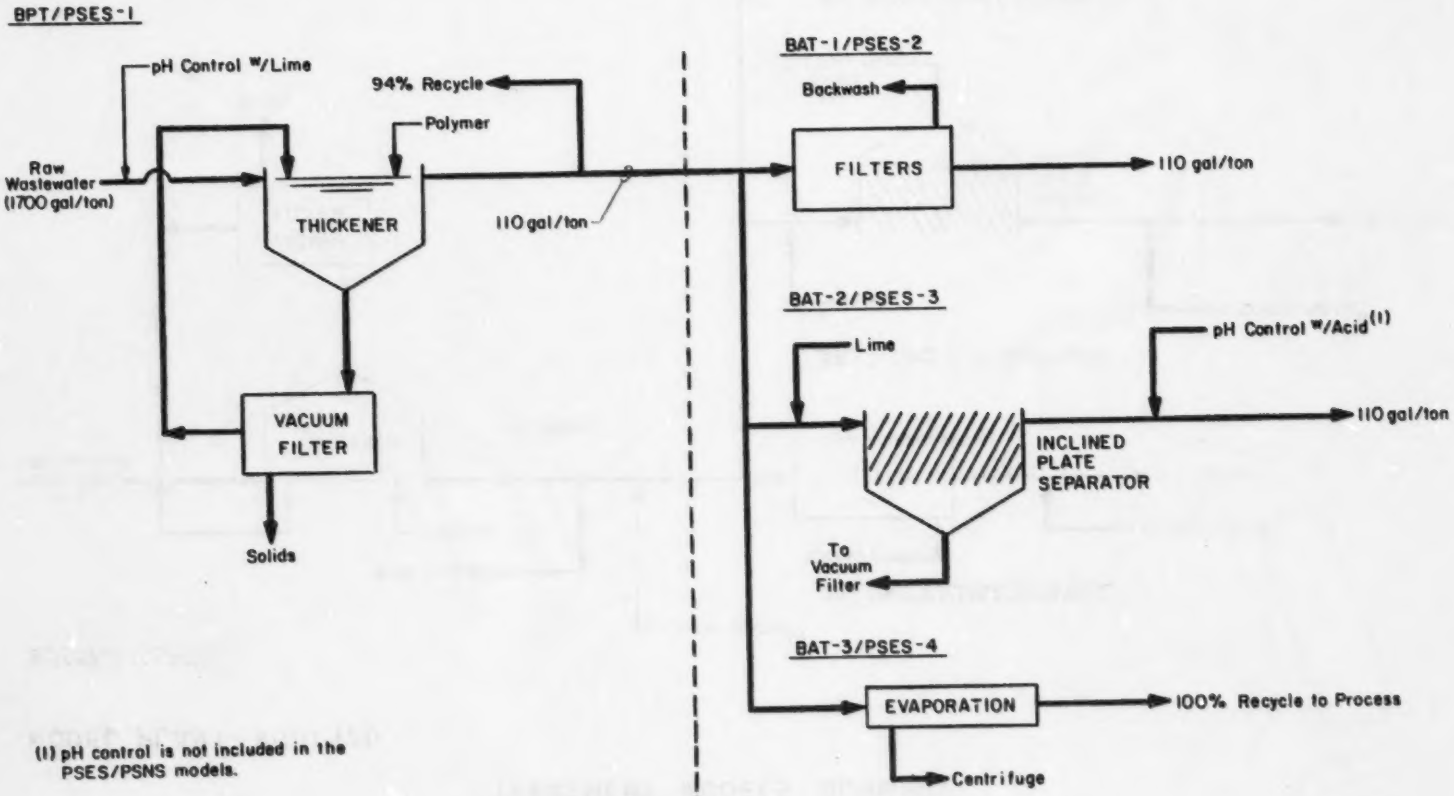
(1) pH Control with acid is a BPT step which is transferred for incorporation with BAT treatment. The cost of this step is not included with the BAT costs, nor is it included in the PSES/PSES models.

# OPEN HEARTH FURNACE - WET TREATMENT MODELS SUMMARY

## MODEL PLANT-6700 TPD

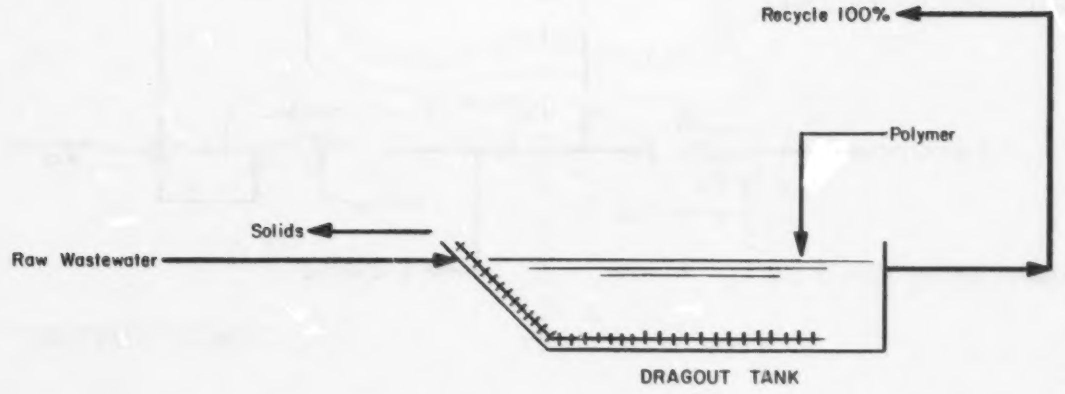


(1) pH control is not included in the PSES/PSNS models.

# ELECTRIC ARC FURNACE-SEMI-WET TREATMENT MODELS SUMMARY

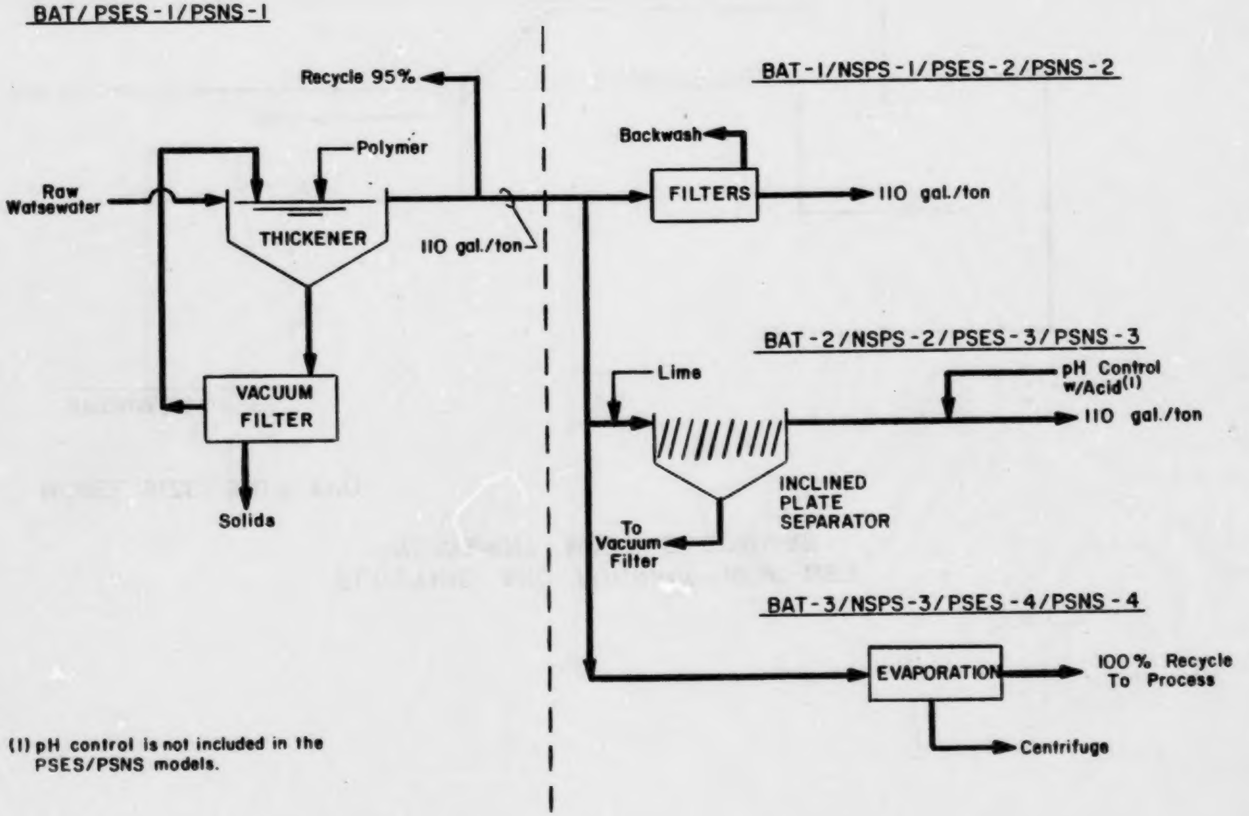
MODEL SIZE - 3100 TPD

BPT/BAT/BCT/PSES



# ELECTRIC ARC FURNACE - WET
# TREATMENT MODELS SUMMARY

## MODEL PLANT - 1800 TPD



(1) pH control is not included in the PSES/PSNS models.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Steelmaking | MODEL SIZE (TPD): | 5300 |
| : | Basic Oxygen Furnace | OPER. DAYS/YEAR : | 365 |
| : | Semi-Wet | TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model Plant | | 1.9 MGD |
| 8 | Direct Dischargers | 15.3 MGD |
| 0 | Indirect Discharger | 0.0 MGD |
| 1 | Zero Discharger | 0.0 MGD |
| 9 | Active Plants | 15.3 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT BAT/PSES |
|---|---|
| Investment | 590 |
| Annual | 100 |
| $/Ton of Production | 0.052 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | |
|---|---|---|---|
| | Flow (GPT) | 360 | 0 |
| | pH (SU) | 10-12 | - |
| | Fluoride | 10 | - |
| | Total Suspended Solids | 375 | - |
| 120 | Copper* | 0.04 | - |
| 122 | Lead* | 1.2 | - |
| 123 | Mercury | 0.002 | - |
| 128 | Zinc* | 1 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: NSPS and PSNS are reserved.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Steelmaking
: Basic Oxygen Furnace
: Wet-Suppressed Combustion

MODEL SIZE (TPD): 7400
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 7.4 MGD |
| 5 Direct Dischargers | 37.0 MGD |
| 1 Indirect Discharger | 7.4 MGD |
| 6 Active Plants | 44.4 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 3170 | 247 | 308 | 4082 |
| Annual | 846 | 33.0 | 42.9 | 817 |
| $/Ton of Production | 0.31 | 0.012 | 0.016 | 0.30 |

| | PSNS-1 | NSPS-1<br>PSNS-2 | NSPS-2<br>PSNS-3 | NSPS-3<br>PSNS-4 |
|---|---|---|---|---|
| Investment | 3122 | 3417 | 3478 | 7204 |
| Annual | 836 | 879 | 889 | 1653 |
| $/Ton of Production | 0.31 | 0.33 | 0.33 | 0.61 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-3<br>PSES-4<br>PSNS-4 |
|---|---|---|---|---|---|
| Flow (GPT) | 1000 | 50 | 50 | 50 | 0 |
| pH (SU) | 7-12 | 6-9 | 6-9 | 6-9 | - |
| Fluoride | 15 | 15 | 15 | 15 | - |
| Total Suspended Solids | 720 | (50)36 | (15)10 | (25)22 | - |
| 118 Cadmium | 0.06 | 0.01 | 0.01 | 0.01 | - |
| 119 Chromium | 0.6 | 0.1 | 0.1 | 0.05 | - |
| 120 Copper* | 0.15 | 0.15 | 0.1 | 0.05 | - |
| 122 Lead* | 8 | 0.5 | (0.5)0.4 | (0.3)0.2 | - |
| 124 Nickel* | 0.3 | 0.3 | 0.25 | 0.15 | - |
| 126 Silver | 0.02 | 0.02 | 0.02 | 0.02 | - |
| 128 Zinc* | 6.8 | 0.7 | (0.5)0.4 | (0.45)0.4 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Steelmaking
: Basic Oxygen Furnace
: Wet-Open Combustion

MODEL SIZE (TPD): 9100
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

| RAW WASTE FLOWS | | |
|---|---|---|
| | Model Plant | 10.0 MGD |
| 13 | Direct Dischargers | 130.1 MGD |
| 1 | Indirect Discharger | 10.0 MGD |
| 14 | Active Plants | 140.1 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 4,738 | 539 | 474 | 7,549 |
| Annual | 1,102 | 74.8 | 69.6 | 1,774 |
| $/Ton of Production | 0.33 | 0.023 | 0.021 | 0.53 |

| | PSNS-1 | NSPS-1<br>PSNS-2 | NSPS-2<br>PSNS-3 | NSPS-3<br>PSNS-4 |
|---|---|---|---|---|
| Investment | 4,617 | 5,277 | 5,212 | 12,166 |
| Annual | 1,076 | 1,177 | 1,172 | 2,850 |
| $/Ton of Production | 0.32 | 0.36 | 0.35 | 0.86 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT PSES-1 PSNS-1 | BAT-1 NSPS-1 PSES-2 PSNS-2 | BAT-2 NSPS-2 PSES-3 PSNS-3 | BAT-3 NSPS-3 PSES-4 PSNS-4 |
|---|---|---|---|---|---|---|
| | Flow (GPT) | 1,100 | 110 | 110 | 110 | 0 |
| | pH (SU) | 8-11 | 6-9 | 6-9 | 6-9 | - |
| | Fluoride | 20 | 20 | 20 | 20 | - |
| | Total Suspended Solids | 4,200 | (50)38 | (15)10 | (25)22 | - |
| 23 | Chloroform | 0.05 | 0.05 | 0.05 | 0.05 | - |
| 115 | Arsenic* | 0.06 | 0.06 | 0.06 | 0.06 | - |
| 118 | Cadmium | 0.4 | 0.01 | 0.01 | 0.01 | - |
| 119 | Chromium* | 5.2 | 0.1 | 0.1 | 0.05 | - |
| 120 | Copper* | 1 | 0.15 | 0.1 | 0.05 | - |
| 122 | Lead* | 3.9 | 0.5 | (0.5)0.4 | (0.3)0.2 | - |
| 123 | Mercury | 0.02 | 0.001 | 0.001 | 0.001 | - |
| 124 | Nickel | 0.4 | 0.3 | 0.25 | 0.15 | - |
| 125 | Selenium | 0.02 | 0.02 | 0.02 | 0.02 | - |
| 126 | Silver | 0.08 | 0.01 | 0.01 | 0.01 | - |
| 127 | Thallium | 0.03 | 0.03 | 0.03 | 0.03 | - |
| 128 | Zinc* | 14 | 0.7 | (0.5)0.4 | (0.45)0.4 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

|  |  |  |  |
|---|---|---|---|
| SUBCATEGORY: | Steelmaking | MODEL SIZE (TPD): | 6700 |
| : | Open Hearth | OPER. DAYS/YEAR : | 365 |
| : | Wet | TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

|  |  |  |
|---|---|---|
| Model Plant |  | 11.4 MGD |
| 4 | Direct Dischargers | 45.6 MGD |
| 0 | Indirect Discharger | 0 0 MGD |
| 4 | Active Plants | 45.6 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 4531 | 521 | 452 | 6336 |
| Annual | 957 | 70.8 | 72.1 | 1404 |
| $/Ton of Production | 0.39 | 0.029 | 0.029 | 0.57 |

|  | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|---|---|
|  | Flow (GPT) | 1700 | 110 | 110 | 110 | 0 |
|  | pH (SU) | 3-7 | 6-9 | 6-9 | 6-9 | - |
|  | Fluoride | 150 | 140 | 140 | 20 | - |
|  | Total Suspended Solids | 1700 | (50)40 | (15)10 | (25)22 | - |
| 120 | Copper* | 1.4 | 0.05 | 0.4 | 0.05 | - |
| 122 | Lead* | 2.8 | 1.5 | (0.35)0.3 | (0.3)0.2 | - |
| 128 | Zinc* | 140 | 4.4 | (5.0)4.4 | (0.45)0.4 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT and PSES-1 costs.
: NSPS and PSNS are reserved.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Steelmaking | MODEL SIZE (TPD): | 3100 |
| : | Electric Arc Furnace | OPER. DAYS/YEAR : | 365 |
| : | Semi-Wet | TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model | Plant | 0.5 MGD |
| 2 | Direct Dischargers | 0.9 MGD |
| 0 | Indirect Discharger | 0 MGD |
| 1 | Zero Discharge | 0.5 MGD |
| 3 | Active Plants | 1.4 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT BAT/PSES |
|---|---|
| Investment | 368 |
| Annual | 79.2 |
| $/Ton of Production | 0.070 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | |
|---|---|---|---|
| | Flow (GPT) | 150 | 0 |
| | pH (SU) | 6-9 | - |
| | Fluoride | 30 | - |
| | Total Suspended Solids | 2200 | - |
| 120 | Copper* | 2.4 | - |
| 122 | Lead* | 33 | - |
| 128 | Zinc* | 120 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: NSPS and PSNS are reserved.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Steelmaking
: Electric Arc Furnace
: Wet

MODEL SIZE (TPD): 1800
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model Plant | | 3.8 MGD |
| 6 | Direct Dischargers | 22.7 MGD |
| 1 | Indirect Discharger | 3.8 MGD |
| 7 | Active Plants | 26.5 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 2268 | 162 | 242 | 2782 |
| Annual | 596 | 21.5 | 35.5 | 512 |
| $/Ton of Production | 0.91 | 0.033 | 0.054 | 0.78 |
| | PSNS-1 | NSPS-1<br>PSNS-2 | NSPS-2<br>PSNS-3 | NSPS-3<br>PSNS-4 |
| Investment | 2268 | 2430 | 2510 | 5049 |
| Annual | 596 | 617 | 631 | 1107 |
| $/Ton of Production | 0.91 | 0.94 | 0.96 | 1.69 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT PSES-1 PSNS-1 | BAT-1 NSPS-1 PSES-2 PSNS-2 | BAT-2 NSPS-2 PSES-3 PSNS-3 | BAT-3 NSPS-3 PSES-4 PSNS-4 |
|---|---|---|---|---|---|---|
| | Flow (GPT) | 2100 | 110 | 110 | 110 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Fluoride | 40 | 35 | 35 | 20 | - |
| | Total Suspended Solids | 3400 | (50)47 | (15)10 | (25)22 | - |
| 39 | Fluoranthene | 0.02 | 0.02 | 0.02 | 0.02 | - |
| 58 | 4-Nitrophenol | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 64 | Pentachlorophenol | 0.01 | 0.01 | 0.01 | 0.01 | - |
| 114 | Antimony* | 0.7 | 0.7 | 0.7 | 0.5 | - |
| 115 | Arsenic* | 1.2 | 0.01 | 0.01 | 0.01 | - |
| 118 | Cadmium* | 3.3 | 1.5 | 1.4 | 0.1 | - |
| 119 | Chromium* | 4.3 | 2 | 1.5 | 1.3 | - |
| 120 | Copper* | 1.3 | 0.15 | 0.15 | 0.1 | - |
| 122 | Lead* | 23 | 1.5 | (1)0.95 | (0.3)0.2 | - |
| 124 | Nickel* | 0.05 | 0.05 | 0.05 | 0.05 | - |
| 126 | Silver* | 0.06 | 0.06 | 0.06 | 0.06 | - |
| 128 | Zinc* | 100 | 20 | (20)19 | (0.45)0.4 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 252.1 | 18.9 | 18.9 | 18.9 | 0 |
| Fluoride | 16,894.6 | 1,130.6 | 1,130.6 | 564.9 | - |
| Total Suspended Solids | 1,121,727.4 | 1,119.1 | 289.4 | 636.6 | - |
| Total Toxic Metals | 20,887.2 | 116.0 | 95.4 | 29.7 | - |
| Total Organics | 11.3 | 1.1 | 1.1 | 1.1 | - |
| SUBCATEGORY COST SUMMARY(1) ($$\times10^{-6}$) | | | | | |
| Investment | - | 112.00 | 11.00 | 10.74 | 156.60 |
| Annual | - | 26.28 | 1.51 | 1.58 | 34.87 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 21.2 | 1.6 | 1.6 | 1.6 | 0 |
| Fluoride | 704.2 | 49.6 | 49.6 | 45.0 | - |
| Total Suspended Solids | 91,715.8 | 92.4 | 23.8 | 52.5 | - |
| Total Toxic Metals | 1,333.2 | 11.7 | 10.0 | 2.8 | - |
| Total Organics | 1.0 | 0.09 | 0.09 | 0.09 | - |
| SUBCATEGORY COST SUMMARY ($$\times10^{-6}$) | | | | | |
| Investment | - | 11.16 | 0.00 | 0.55 | 0.00 |
| Annual | - | 2.79 | 0.00 | 0.071 | 0.00 |

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(1) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY
## BASIC OXYGEN FURNACE - SEMI-WET

| | DIRECT DISCHARGERS | |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT |
| Flow (MGD) | 15.3 | 0 |
| Fluoride | 232.5 | - |
| Total Suspended Solids | 8,717.4 | - |
| Total Toxic Metals | 52.1 | - |
| Total Organics | - | - |
| SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$) | | |
| Investment | - | 4.31 |
| Annual | - | 0.65 |

---

Note: There are no indirect dischargers in this segment.

(1) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY
## BASIC OXYGEN FURNACE - WET-SUPPRESSED COMBUSTION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 37.0 | 1.8 | 1.8 | 1.8 | 0 |
| Fluoride | 845.2 | 42.3 | 42.3 | 42.3 | - |
| Total Suspended Solids | 40,571.7 | 101.4 | 28.2 | 62.0 | - |
| Total Toxic Metals | 897.6 | 5.0 | 3.6 | 2.5 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 15.81 | 1.23 | 1.54 | 20.36 |
| Annual | - | 4.22 | 0.16 | 0.21 | 4.08 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 7.4 | 0.4 | 0.4 | 0.4 | 0 |
| Fluoride | 169.0 | 8.5 | 8.5 | 8.5 | - |
| Total Suspended Solids | 8,114.3 | 20.3 | 5.6 | 12.4 | - |
| Total Toxic Metals | 179.5 | 1.0 | 0.7 | 0.5 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 3.06 | 0.00 | 0.00 | 0.00 |
| Annual | - | 0.82 | 0.00 | 0.00 | 0.00 |

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY
## BASIC OXYGEN FURNACE - WET-OPEN COMBUSTION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 130.1 | 13.0 | 13.0 | 13.0 | 0 |
| Fluoride | 3,963.7 | 396.4 | 396.4 | 396.4 | - |
| Total Suspended Solids | 832,369.1 | 753.1 | 198.2 | 436.0 | - |
| Total Toxic Metals | 4,976.4 | 37.3 | 27.4 | 19.4 | - |
| Total Organics | 9.9 | 1.0 | 1.0 | 1.0 | - |
| **SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$)** | | | | | |
| Investment | - | 58.62 | 6.69 | 5.88 | 93.59 |
| Annual | - | 13.64 | 0.93 | 0.86 | 22.00 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 10.0 | 1.0 | 1.0 | 1.0 | 0 |
| Fluoride | 304.9 | 30.5 | 30.5 | 30.5 | - |
| Total Suspended Solids | 64,028.4 | 57.9 | 15.2 | 33.5 | - |
| Total Toxic Metals | 382.8 | 2.9 | 2.1 | 1.5 | - |
| Total Organics | 0.8 | 0.08 | 0.08 | 0.08 | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 5.37 | 0.00 | 0.37 | 0.00 |
| Annual | - | 1.25 | 0.00 | 0.048 | 0.00 |

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(1) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY
## OPEN HEARTH - WET

| | DIRECT DISCHARGERS | | | | |
|---|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
| Flow (MGD) | 45.6 | 2.9 | 2.9 | 2.9 | 0 |
| Fluoride | 10,407.9 | 628.6 | 628.6 | 89.8 | - |
| Total Suspended Solids | 117,956.5 | 179.6 | 44.9 | 98.8 | - |
| Total Toxic Metals | 10,005.5 | 26.7 | 21.3 | 2.9 | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | | | | |
| Investment | - | 17.78 | 2.05 | 1.77 | 24.89 |
| Annual | - | 3.75 | 0.28 | 0.28 | 5.52 |

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Note: There are no indirect dischargers in this subdivision.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY
## ELECTRIC ARC FURNACE - SEMI-WET

|  | DIRECT DISCHARGERS |  |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT |
| Flow (MGD) | 1.4 | 0 |
| Fluoride | 63.7 | - |
| Total Suspended Solids | 4,674.0 | - |
| Total Toxic Metals | 330.2 | - |
| Total Organics | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) |  |  |
| Investment | - | 1.00 |
| Annual | - | 0.22 |

---

Note: There are no indirect dischargers in this segment.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## STEELMAKING SUBCATEGORY
## ELECTRIC ARC FURNACE - WET

DIRECT DISCHARGERS

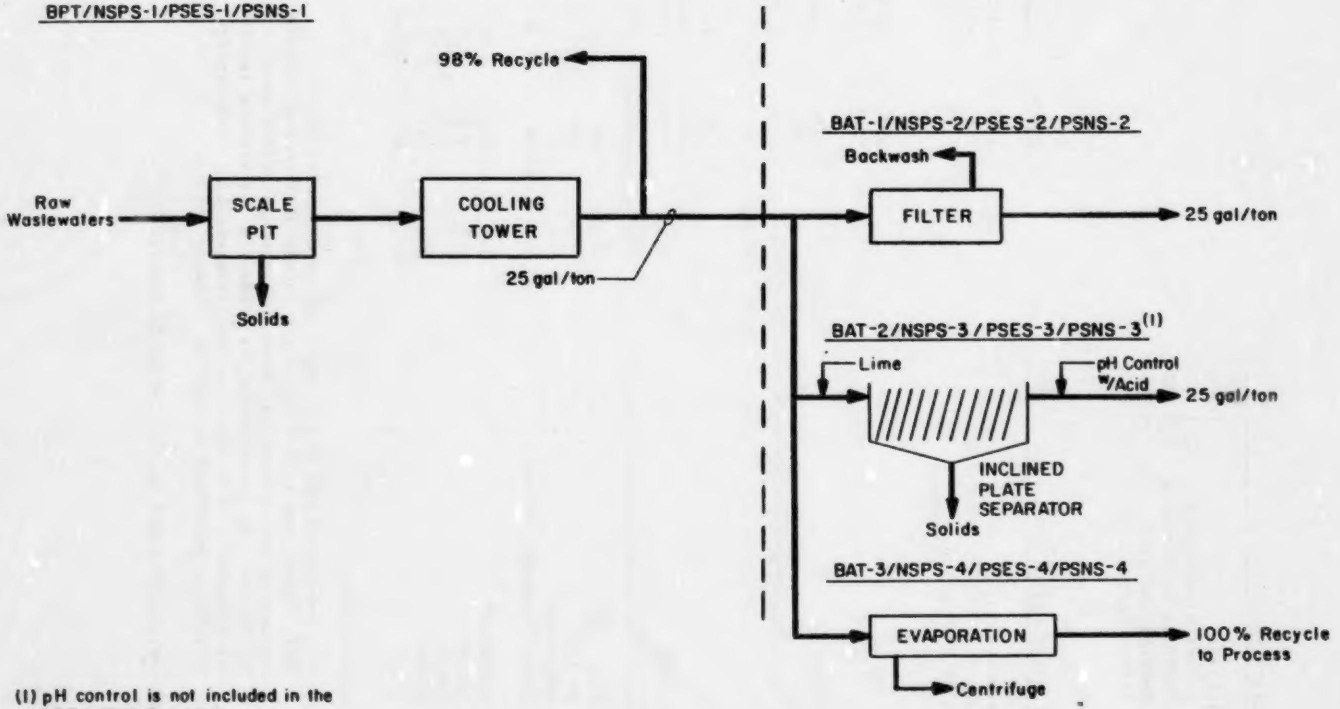
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 22.7 | 1.2 | 1.2 | 1.2 | 0 |
| Fluoride | 1,381.6 | 63.3 | 63.3 | 36.2 | - |
| Total SuspendedSolids | 117,438.7 | 85.0 | 18.1 | 39.8 | - |
| Total Toxic Metals | 4,625.4 | 47.0 | 43.1 | 4.9 | - |
| Total Organics | 1.4 | 0.07 | 0.07 | 0.07 | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 14.48 | 1.03 | 1.55 | 17.76 |
| Annual | - | 3.80 | 0.14 | 0.23 | 3.27 |

INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 3.8 | 0.2 | 0.2 | 0.2 | 0 |
| Fluoride | 230.3 | 10.6 | 10.6 | 6.0 | - |
| Total Suspended Solids | 19,573.1 | 14.2 | 3.0 | 6.6 | - |
| Total Toxic Metals | 770.9 | 7.8 | 7.2 | 0.8 | - |
| Total Organics | 0.2 | 0.01 | 0.01 | 0.01 | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 2.73 | 0.00 | 0.18 | 0.00 |
| Annual | - | 0.72 | 0.00 | 0.023 | 0.22 |

# VACUUM DEGASSING
# TREATMENT MODELS SUMMARY

## MODEL PLANT-1200 TPD



(1) pH control is not included in the PSES/PSNS models.

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## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Vacuum Degassing
: Carbon and Specialty

MODEL SIZE (TPD): 1200
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

| RAW WASTE FLOWS | | |
|---|---|---|
| Model Plant | | 1.7 MGD |
| 31 | Direct Dischargers | 52.1 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 2 | Zero Dischargers | 3.4 MGD |
| 33 | Active Plants | 55.5 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 1116 | 32.0 | 124 | 1479 |
| Annual | 166 | 4.3 | 17.3 | 201 |
| $/Ton of Production | 0.38 | 0.0098 | 0.039 | 0.46 |
| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 | NSPS-4<br>PSNS-4 |
| Investment | 1116 | 1148 | 1240 | 2595 |
| Annual | 166 | 171 | 184 | 368 |
| $/Ton of Production | 0.38 | 0.39 | 0.42 | 0.84 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-4<br>PSES-4<br>PSNS-4 |
|---|---|---|---|---|---|
| Flow (GPT) | 1400 | 25 | 25 | 25 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Manganese | 5 | 5 | 5 | 1 | - |
| Total Suspended Solids | 60 | (50)34 | (15)10 | (25)22 | - |
| 119 Chromium* | 0.5 | 0.5 | 0.5 | 0.1 | - |
| 120 Copper* | 0.3 | 0.1 | 0.1 | 0.1 | - |
| 122 Lead* | 1 | 0.7 | (0.7)0.7 | (0.3)0.2 | - |
| 124 Nickel | 0.1 | 0.1 | 0.1 | 0.1 | - |
| 128 Zinc* | 6 | 4.5 | (4.5)4.5 | (0.45)0.4 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## VACUUM DEGASSING SUBCATEGORY

| | DIRECT DISCHARGERS(1) | | | | |
|---|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
| Flow (MGD) | 55.4 | 0.9 | 0.9 | 0.9 | 0 |
| Manganese | 422.2 | 7.1 | 7.1 | 1.4 | - |
| Total Suspended Solids | 5,066.0 | 48.2 | 14.2 | 31.2 | - |
| Total Toxic Metals | 667.0 | 8.4 | 8.4 | 1.3 | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY(2) ($\$X10^{-6}$) | | | | | |
| Investment | - | 27.90 | 0.78 | 3.03 | 36.00 |
| Annual | - | 4.10 | 0.10 | 0.42 | 4.90 |

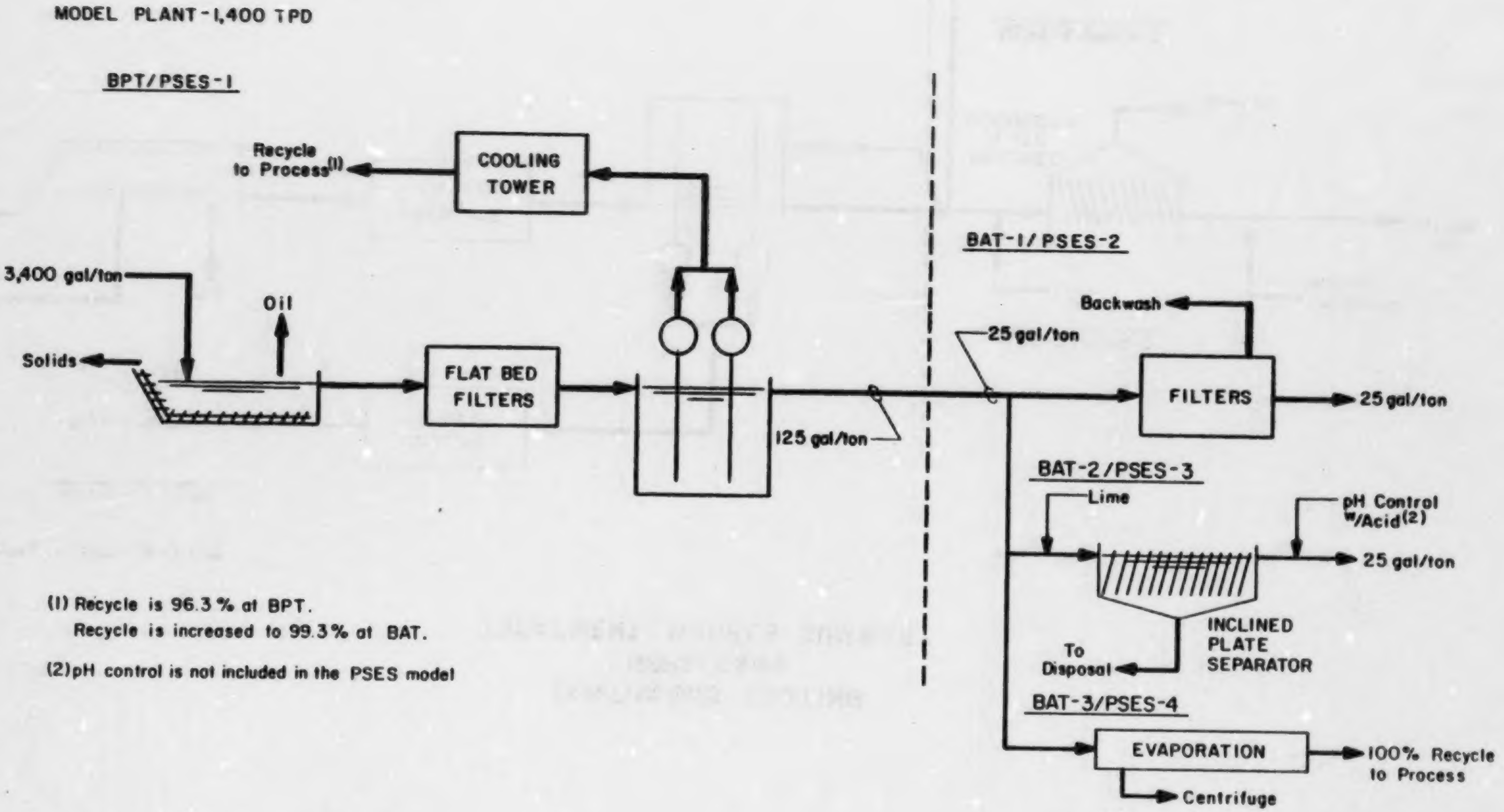
---

Note: There are no indirect dischargers in this subcategory.

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in this data. However, as these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

# CONTINUOUS CASTING
# BPT/BAT/PSES
# TREATMENT MODELS SUMMARY



(1) Recycle is 96.3% at BPT.
Recycle is increased to 99.3% at BAT.

(2) pH control is not included in the PSES model

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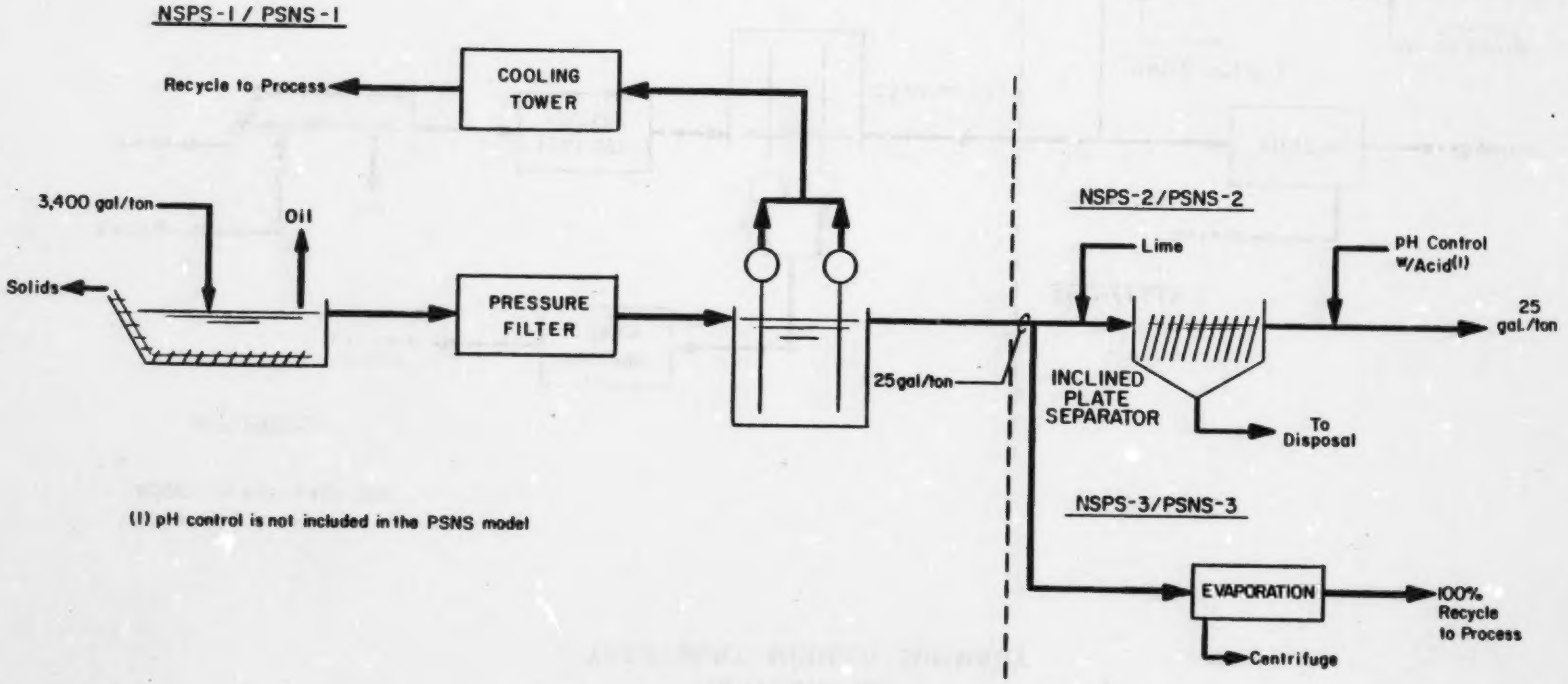
# CONTINUOUS CASTING
# NSPS/PSNS
# TREATMENT MODELS SUMMARY

MODEL PLANT - 1,400 TPD



(1) pH control is not included in the PSNS model

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| SUBCATEGORY: Continuous Casting | |
|---|---|
| MODEL SIZE (TPD): | 1400 |
| OPER. DAYS/YEAR : | 365 |
| TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| | Model Plant | 4.8 MGD |
| 25 | Direct Dischargers | 119.0 MGD |
| 7 | Indirect Dischargers | 33.3 MGD |
| 17 | Zero Dischargers | 80.9 MGD |
| 49 | Active Plants | 233.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 2304 | 35.4 | 124 | 1581 |
| Annual | 356 | 4.8 | 17.3 | 219 |
| $/Ton of Production | 0.70 | 0.0094 | 0.034 | 0.43 |
| | | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
| Investment | | 3442 | 3566 | 5023 |
| Annual | | 499 | 516 | 718 |
| $/Ton of Production | | 0.98 | 1.01 | 1.40 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT PSES-1 | BAT-1 NSPS-1 PSES-2 PSNS-1 | BAT-2 NSPS-2 PSES-3 PSNS-2 | BAT-3 NSPS-3 PSES-4 PSNS-3 |
|---|---|---|---|---|---|
| Flow (GPT) | 3400 | 125 | 25 | 25 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Oil and Grease | 25 | (15)10 | (5**)2.0 | (10)4.4 | - |
| Total Suspended Solids | 60 | (50)40 | (15)9.8 | (25)22 | - |
| 119 Chromium | 0.65 | 0.65 | 0.65 | 0.65 | - |
| 120 Copper | 0.11 | 0.11 | 0.11 | 0.1 | - |
| 122 Lead | 0.08 | 0.08 | (0.1)0.08 | (0.3)0.08 | - |
| 125 Selenium | 0.08 | 0.08 | 0.08 | 0.08 | - |
| 128 Zinc | 0.7 | 0.7 | (0.7)0.7 | (0.45)0.4 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## CONTINUOUS CASTING SUBCATEGORY

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 199.9 | 4.4 | 0.9 | 0.9 | 0 |
| Oil and Grease | 7,611.8 | 66.6 | 2.7 | 5.9 | - |
| Total Suspended Solids | 18,268.2 | 266.5 | 13.1 | 29.3 | - |
| Total Toxic Metals | 493.2 | 10.8 | 2.2 | 1.7 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$)** | | | | | |
| Investment | - | 64.39 | 0.88 | 3.05 | 39.75 |
| Annual | - | 9.38 | 0.12 | 0.42 | 5.50 |

### INDIRECT (POTW) DISCHARGERS

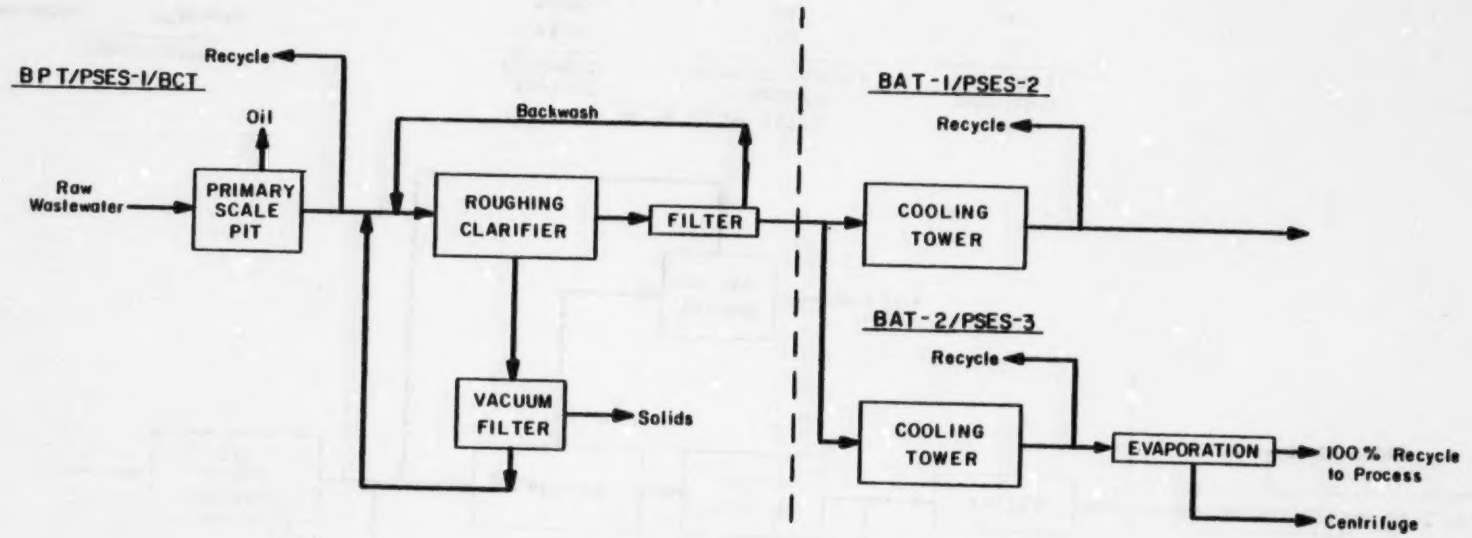
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 33.3 | 1.2 | 0.2 | 0.2 | 0 |
| Oil and Grease | 1,268.6 | 18.7 | 0.7 | 1.6 | - |
| Total Suspended Solids | 3,044.7 | 74.6 | 3.7 | 8.2 | - |
| Total Toxic Metals | 82.2 | 3.0 | 0.6 | 0.5 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 8.90 | 0.14 | 0.77 | 8.54 |
| Annual | - | 1.33 | 0.02 | 0.09 | 1.18 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

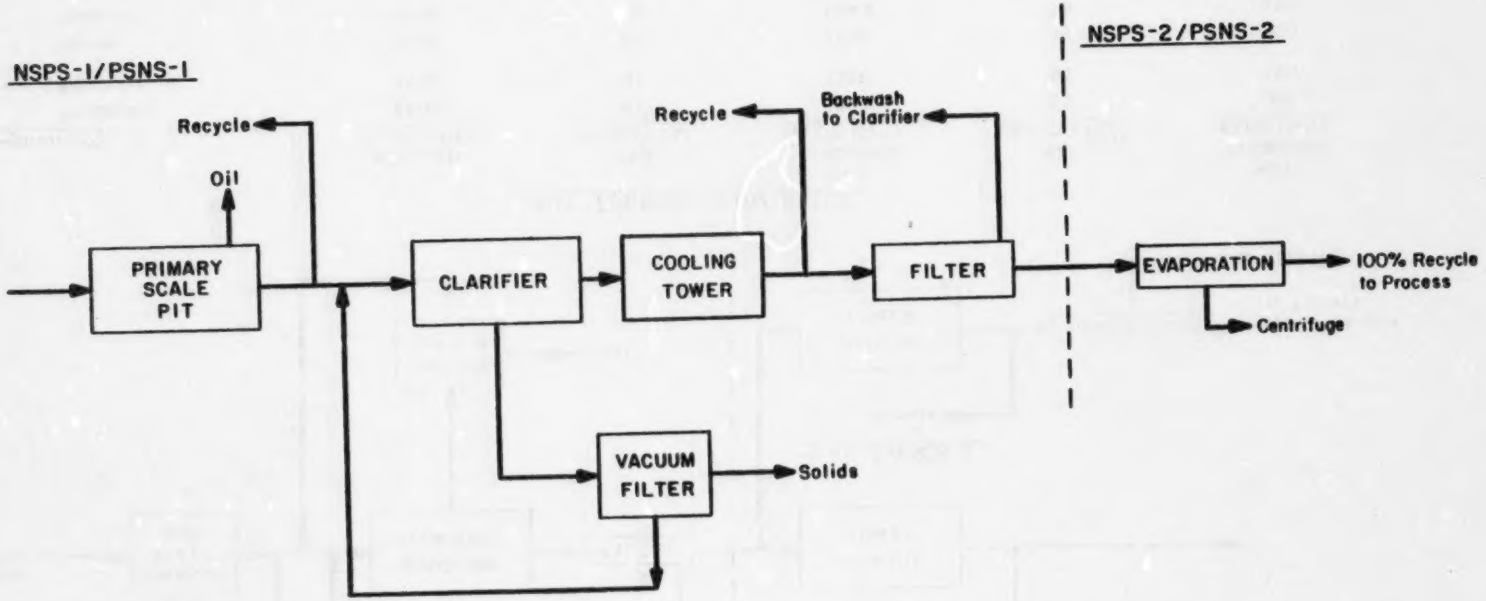
# HOT FORMING
# BPT/BCT/BAT/PSES
# TREATMENT MODELS SUMMARY



## HOT FORMING FLOW RATES

| SUBDIVISION | | APPLIED FLOW (GPT) | PSP RECYCLE (%) | BPT DISCHARGE FLOW (GPT) | BAT RECYCLE (%)(1) | BAT DISCHARGE FLOW (GPT) |
|---|---|---|---|---|---|---|
| PRIMARY | wo/Scarfer | 2300 | 61 | 897 | 35 | 90 |
| | w/Scarfer | 3400 | 61 | 1326 | 35 | 140 |
| SECTION | Carbon | 5100 | 58 | 2142 | 38 | 200 |
| | Specialty | 3200 | 58 | 1344 | 38 | 130 |
| FLAT | Hot Strip | 6400 | 60 | 2560 | 36 | 260 |
| | Carbon Plate | 3400 | 60 | 1360 | 36 | 140 |
| | Specialty Plate | 1500 | 60 | 600 | 36 | 60 |
| PIPE & TUBE | | 5520 | 77 | 1270 | 19 | 220 |

# HOT FORMING
# NSPS/PSNS
# TREATMENT MODELS SUMMARY



| SUBDIVISION | | NSPS FLOW RATES | | |
|---|---|---|---|---|
| | | APPLIED FLOW(GPT) | COMBINED RECYCLE RATE(%) | DISCHARGE FLOW (GPT) |
| PRIMARY | $^{wo}$/scarfer | 2300 | 96 | 90 |
| | $^{w}$/scarfer | 3400 | 96 | 140 |
| SECTION | Carbon | 5100 | 96 | 200 |
| | Specialty | 3200 | 96 | 130 |
| FLAT | Hot Strip | 6400 | 96 | 260 |
| | Carbon Plate | 3400 | 96 | 140 |
| | Specialty Plate | 1500 | 96 | 60 |
| PIPE & TUBE | | 5520 | 96 | 220 |

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: All Subdivisions

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| 227 | Direct Dischargers | 3,594.6 MGD |
| 18 | Indirect Dischargers | 294.5 MGD |
| 9 | Zero Dischargers | 85.2 MGD |
| 262 | Active Plants | 3,974.3 MGD |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BAT-1 BPT BCT PSES-1 | BAT-2 NSPS-1 PSES-2 PSNS-1 | NSPS-2 PSES-3 PSNS-2 |
|---|---|---|---|---|---|
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 30-130 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 790-3300 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | <0.05-12 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 0.3-20 | 0.011 | 0.011 | - |
| 122 | Lead | <0.05-11 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 0.8-20 | 0.006 | 0.006 | - |
| 128 | Zinc | 0.6-5.4 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: Values in parentheses represent the concentrations used to develop the limitations for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

# SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Primary
: Carbon With Scarfers

MODEL SIZE (TPD): 7400
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

| | | |
|---|---|---|
| | Model Plant | 25.2 MGD |
| 30 | Direct Dischargers | 754.8 MGD |
| 2 | Indirect Dischargers | 50.3 MGD |
| 32 | Active Plants | 805.1 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 4863 | 2558 | 10132 | 5568 | 13141 |
| Annual | -698 | 392 | 1934 | -556 | 986 |
| $/Ton of Production | -0.36 | 0.20 | 1.01 | -0.29 | 0.51 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 3400 | 1326 | 140 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 56 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 3000 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 1.3 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 5.7 | 0.011 | 0.011 | - |
| 122 | Lead | 6.5 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 5.7 | 0.006 | 0.006 | - |
| 128 | Zinc | 3.1 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Primary
: Carbon Without Scarfers

MODEL SIZE (TPD): 3800
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

| RAW WASTE FLOWS | | |
|---|---|---|
| Model Plant | | 8.7 MGD |
| 30 | Direct Dischargers | 262.2 MGD |
| 2 | Indirect Dischargers | 17.5 MGD |
| 1 | Zero Discharger | 8.7 MGD |
| 33 | Active Plants | 288.4 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 2300 | 1240 | 5187 | 2868 | 6816 |
| Annual | -44.5 | 184 | 884 | 46 | 746 |
| $/Ton of Production | -0.04 | 0.19 | 0.89 | 0.05 | 0.76 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 2300 | 897 | 90 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 85 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 2200 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 1.9 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 11 | 0.011 | 0.011 | - |
| 122 | Lead | 7.5 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 4.6 | 0.006 | 0.006 | - |
| 128 | Zinc | 4.0 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Hot Forming | MODEL SIZE (TPD): | 1850 |
| : | Primary | OPER. DAYS/YEAR : | 260 |
| : | Specialty With Scarfers | TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model Plant | | 6.3 MGD |
| 5 | Direct Dischargers | 31.4 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 5 | Active Plants | 31.4 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1963 | 1022 | 4243 | 2610 | 5832 |
| Annual | -68.9 | 151 | 703 | 27.8 | 580 |
| $/Ton of Production | -0.14 | 0.31 | 1.46 | 0.06 | 1.21 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 3400 | 1326 | 140 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 56 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 3000 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 12 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 20 | 0.001 | 0.001 | - |
| 122 | Lead | 2.8 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 12 | 0.006 | 0.006 | - |
| 128 | Zinc | 4.1 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Primary
: Specialty Without Scarfers

MODEL SIZE (TPD): 1200
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 2.8 MGD |
| 11 Direct Dischargers | 30.4 MGD |
| 2 Indirect Dischargers | 5.5 MGD |
| 1 Zero Discharger | 2.8 MGD |
| 14 Active Plants | 38.7 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1361 | 676 | 2946 | 1804 | 4073 |
| Annual | 71.5 | 95.8 | 445 | 134 | 484 |
| $/Ton of Production | 0.23 | 0.31 | 1.43 | 0.43 | 1.55 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT BCT PSES-1 | BAT-1 NSPS-1 PSES-2 PSNS-1 | BAT-2 NSPS-2 PSES-3 PSNS-2 |
|---|---|---|---|---|
| Flow (GPT) | 2300 | 897 | 90 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | - |
| Oil and Grease | 85 | (5**)2.0 | (5**)2.0 | - |
| Total Suspended Solids | 2200 | (15)9.8 | (15)9.8 | - |
| 119 Chromium | <0.05 | 0.001 | (0.10)0.001 | - |
| 120 Copper | 0.3 | 0.011 | 0.011 | - |
| 122 Lead | <0.05 | 0.007 | (0.10)0.007 | - |
| 124 Nickel | 13 | 0.006 | 0.006 | - |
| 128 Zinc | 1.9 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Hot Forming | MODEL SIZE (TPD): | 3050 |
| : | Section | OPER. DAYS/YEAR : | 260 |
| : | Carbon | TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| | Model Plant | 15.6 MGD |
| 48 | Direct Dischargers | 746.6 MGD |
| 7 | Indirect Dischargers | 108.9 MGD |
| 4 | Zero Discharges | 62.2 MGD |
| 59 | Active Plants | 917.7 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 3985 | 1715 | 7446 | 4163 | 9894 |
| Annual | 267 | 266 | 1350 | 327 | 1411 |
| $/Ton of Production | 0.34 | 0.34 | 1.70 | 0.41 | 1.78 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT BCT PSES-1 | BAT-1 NSPS-1 PSES-2 PSNS-1 | BAT-2 NSPS-2 PSES-3 PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 5100 | 2142 | 200 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 38 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 990 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 0.4 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 1.9 | 0.011 | 0.011 | - |
| 122 | Lead | 0.4 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 1.3 | 0.006 | 0.006 | - |
| 128 | Zinc | 5.4 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Section
: Specialty

MODEL SIZE (TPD): 1200
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| | Model Plant | 3.8 MGD |
| 17 | Direct Dischargers | 65.3 MGD |
| 1 | Indirect Dischargers | 3.8 MGD |
| 3 | Zero Dischargers | 11.5 MGD |
| 21 | Active Plants | 80.6 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1525 | 815 | 3297 | 1891 | 4372 |
| Annual | 94.0 | 117 | 518 | 150 | 550 |
| $/Ton of Production | 0.30 | 0.38 | 1.66 | 0.48 | 1.76 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT BCT PSES-1 | BAT-1 NSPS-1 PSES-2 PSNS-1 | BAT-2 NSPS-2 PSES-3 PSNS-2 |
|---|---|---|---|---|
| Flow (GPT) | 3200 | 1344 | 130 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | - |
| Oil and Grease | 60 | (5**)2.0 | (5**)2.0 | - |
| Total Suspended Solids | 1600 | (15)9.8 | (15)9.8 | - |
| 119 Chromium | 0.8 | 0.001 | (0.10)0.001 | - |
| 120 Copper | 2.9 | 0.011 | 0.011 | - |
| 122 Lead | 3.2 | 0.007 | (0.10)0.007 | - |
| 124 Nickel | 6.3 | 0.006 | 0.006 | - |
| 128 Zinc | 1.4 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Flat
: Carbon Hot Strip and Sheet

MODEL SIZE (TPD): 7250
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 46.4 MGD |
| 30 Direct Dischargers | 1392.0 MGD |
| 2 Indirect Dischargers | 92.8 MGD |
| 32 Active Plants | 1484.8 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 6589 | 3941 | 18253 | 8314 | 22625 |
| Annual | 270 | 617 | 3504 | 585 | 3472 |
| $/Ton of Production | 0.14 | 0.33 | 1.86 | 0.31 | 1.84 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|
| Flow (GPT) | 6400 | 2560 | 260 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | - |
| Oil and Grease | 30 | (5**)2.0 | (5**)2.0 | - |
| Total Suspended Solids | 790 | (15)9.8 | (15)9.8 | - |
| 119 Chromium | 1.8 | 0.001 | (0.10)0.001 | - |
| 120 Copper | 0.4 | 0.011 | 0.011 | - |
| 122 Lead | 0.7 | 0.007 | (0.10)0.007 | - |
| 124 Nickel | 0.8 | 0.006 | 0.006 | - |
| 128 Zinc | 1.3 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

**SUBCATEGORY:** Hot Forming
: Flat
: Specialty Hot Strip and Sheet

MODEL SIZE (TPD): 900
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 5.8 MGD |
| 7 Direct Dischargers | 40.3 MGD |
| 0 Indirect Dischargers | 0.0 MGD |
| 7 Active Plants | 40.3 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1871 | 1000 | 4053 | 2318 | 5371 |
| Annual | 174 | 148 | 666 | 246 | 764 |
| $/Ton of Production | C.74 | 0.63 | 2.85 | 1.05 | 3.26 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 6400 | 2560 | 260 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 30 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 790 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 1.9 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 0.3 | 0.011 | 0.011 | - |
| 122 | Lead | <0.05 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 3.4 | 0.006 | 0.006 | - |
| 128 | Zinc | 0.6 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Hot Forming | MODEL SIZE (TPD): | 1000 |
| : | Flat | OPER. DAYS/YEAR : | 260 |
| : | Specialty Plate | TURNS/DAY : | 3 |

RAW WASTE FLOWS

| | | |
|---|---|---|
| | Model Plant | 1.5 MGD |
| 5 | Direct Dischargers | 7.5 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 5 | Active Plants | 7.5 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1112 | 642 | 2588 | 1343 | 3289 |
| Annual | 53.6 | 91.5 | 370 | 90.9 | 370 |
| $/Ton of Production | 0.20 | 0.35 | 1.42 | 0.35 | 1.42 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 1500 | 600 | 60 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 130 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 3400 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 2.9 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 5.1 | 0.011 | 0.011 | - |
| 122 | Lead | 11 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 20 | 0.006 | 0.006 | - |
| 128 | Zinc | 1.9 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based on 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Flat
: Carbon Plate

MODEL SIZE (TPD): 3150
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| | Model Plant | 10.7 MGD |
| 11 | Direct Dischargers | 117.8 MGD |
| 1 | Indirect Dischargers | 10.7 MGD |
| 12 | Active Plants | 128.5 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 |
|---|---|---|---|---|---|
| Investment | 2619 | 1390 | 5851 | 3258 | 7720 |
| Annual | 63.8 | 210 | 802 | 172 | 764 |
| $/Ton of Production | 0.08 | 0.26 | 0.98 | 0.21 | 0.93 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT BCT PSES-1 | BAT-1 NSPS-1 PSES-2 PSNS-1 | BAT-2 NSPS-2 PSES-3 PSNS-2 |
|---|---|---|---|---|
| Flow (GPT) | 3400 | 1360 | 140 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | - |
| Oil and Grease | 56 | (5**)2.0 | (5**)2.0 | - |
| Total Suspended Solids | 1500 | (15)9.8 | (15)9.8 | - |
| 119 Chromium | 1.3 | 0.001 | (0.10)0.001 | - |
| 120 Copper | 4.9 | 0.011 | 0.011 | - |
| 122 Lead | 2.1 | 0.007 | (0.10)0.007 | - |
| 124 Nickel | 3.9 | 0.006 | 0.006 | - |
| 128 Zinc | 1.8 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Pipe and Tube
: Carbon

MODEL SIZE (TPD): 900
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model Plant | | 5.0 MGD |
| 25 | Direct Dischargers | 124.2 MGD |
| 1 | Indirect Dischargers | 5.0 MGD |
| 26 | Active Plants | 129.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1572 | 676 | 3470 | 1871 | 4664 |
| Annual | 197 | 95.8 | 562 | 241 | 708 |
| $/Ton of Production | 0.84 | 0.41 | 2.40 | 1.03 | 3.02 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT BCT PSES-1 | BAT-1 NSPS-1 PSES-2 PSNS-1 | BAT-2 NSPS-2 PSES-3 PSNS-2 |
|---|---|---|---|---|
| Flow (GPT) | 5520 | 1270 | 220 | 0 |
| pH (SU) | 6-9 | 6-9 | 6-9 | - |
| Oil and Grease | 56 | (5**)2.0 | (5**)2.0 | - |
| Total Suspended Solids | 1500 | (15)9.8 | (15)9.8 | - |
| 119 Chromium | 2.9 | 0.001 | (0.10)0.001 | - |
| 120 Copper | 5.1 | 0.011 | 0.011 | - |
| 122 Lead | 11 | 0.007 | (0.10)0.007 | - |
| 124 Nickel | 20 | 0.006 | 0.006 | - |
| 128 Zinc | 1.9 | 0.049 | (0.15)0.049 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Hot Forming | MODEL SIZE (TPD): | 500 |
| : | Pipe and Tube | OPER. DAYS/YEAR : | 260 |
| : | Specialty | TURNS/DAY : | 3 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| | Model Plant | 2.8 MGD |
| 8 | Direct Dischargers | 22.1 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 8 | Active Plants | 22.1 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT<br>BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|---|
| Investment | 1264 | 642 | 2911 | 1544 | 3814 |
| Annual | 125 | 91.5 | 440 | 167 | 516 |
| $/Ton of Production | 0.95 | 0.70 | 3.38 | 1.29 | 3.97 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT<br>BCT<br>PSES-1 | BAT-1<br>NSPS-1<br>PSES-2<br>PSNS-1 | BAT-2<br>NSPS-2<br>PSES-3<br>PSNS-2 |
|---|---|---|---|---|---|
| | Flow (GPT) | 5520 | 1270 | 220 | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 56 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 1500 | (15)9.8 | (15)9.8 | - |
| 119 | Chromium | 0.2 | 0.001 | (0.10)0.001 | - |
| 120 | Copper | 0.9 | 0.011 | 0.011 | - |
| 122 | Lead | 2.1 | 0.007 | (0.10)0.007 | - |
| 124 | Nickel | 1.3 | 0.006 | 0.006 | - |
| 128 | Zinc | 1.7 | 0.049 | (0.15)0.049 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS HOT FORMING SUBCATEGORY

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(2) WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 3,679.9 | 1,418.5 | 145.2 | 0 |
| Oil and Grease | 174,540.2 | 3,077.6 | 314.5 | - |
| Total Suspended Solids | 5,878,201.0 | 15,081.0 | 1,540.8 | - |
| Total Toxic Metals | 49,460.4 | 113.9 | 11.6 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$) | | | | |
| Investment | - | 460.28 | 279.24 | 1,454.59 |
| Annual | - | -29.03 | 42.86 | 267.05 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 294.5 | 124.7 | 11.9 | 0 |
| Oil and Grease | 13,776.7 | 355.2 | 25.7 | - |
| Total Suspended Solids | 444,155.8 | 1,337.6 | 125.6 | - |
| Total Toxic Metals | 3,504.5 | 9.2 | 0.9 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$) | | | | |
| Investment | - | 32.50 | 23.10 | 108.61 |
| Annual | - | -1.30 | 3.68 | 19.26 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Raw waste loads for zero discharge plants have been included in these totals.

(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - PRIMARY
## CARBON WITH SCARFERS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 754.8 | 294.4 | 31.1 | 0 |
| Oil and Grease | 45,857.4 | 638.7 | 67.4 | - |
| Total Suspended Solids | 2,456,647.6 | 3,129.8 | 330.4 | - |
| Total Toxic Metals | 18,261.1 | 23.6 | 2.5 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 97.23 | 61.21 | 271.62 |
| Annual | - | -26.94 | 9.65 | 52.49 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 50.3 | 19.6 | 2.1 | 0 |
| Oil and Grease | 3,057.2 | 42.6 | 4.5 | - |
| Total Suspended Solids | 163,776.5 | 208.7 | 22.0 | - |
| Total Toxic Metals | 1,217.4 | 1.6 | 0.2 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 4.36 | 3.10 | 12.28 |
| Annual | - | -1.03 | 0.47 | 2.34 |

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - PRIMARY
## CARBON WITHOUT SCARFERS

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(2) WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 270.9 | 102.3 | 10.3 | 0 |
| Oil and Grease | 24,985.1 | 221.9 | 22.3 | - |
| Total Suspended Solids | 646,674.2 | 1,087.2 | 109.1 | - |
| Total Toxic Metals | 8,524.3 | 8.2 | 0.8 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$)** | | | | |
| Investment | - | 44.00 | 25.10 | 120.77 |
| Annual | - | -3.97 | 3.63 | 20.60 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 17.5 | 6.8 | 0.7 | 0 |
| Oil and Grease | 1,611.9 | 14.8 | 1.5 | - |
| Total Suspended Solids | 41,720.9 | 72.5 | 7.3 | - |
| Total Toxic Metals | 550.0 | 0.6 | 0.05 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$)** | | | | |
| Investment | - | 5.64 | 2.82 | 14.50 |
| Annual | - | -0.29 | 0.42 | 2.49 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Raw waste loads for zero discharge plants have been included in these totals.

(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - PRIMARY
## SPECIALTY WITH SCARFERS

DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 31.5 | 12.3 | 1.3 | 0 |
| Oil and Grease | 1,910.7 | 26.6 | 2.8 | - |
| Total Suspended Solids | 102,360.3 | 130.4 | 13.8 | - |
| Total Toxic Metals | 1,736.7 | 1.0 | 0.1 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 6.74 | 4.72 | 25.22 |
| Annual | - | -0.75 | 0.67 | 4.18 |

---

Note: There are no indirect (POTW) dischargers in this segment.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - PRIMARY
## SPECIALTY WITHOUT SCARFERS

DIRECT DISCHARGERS[1]

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW[2] WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 33.1 | 11.8 | 1.2 | 0 |
| Oil and Grease | 3,054.1 | 25.7 | 2.6 | - |
| Total Suspended Solids | 79,050.2 | 125.9 | 12.6 | - |
| Total Toxic Metals | 546.2 | 1.0 | 0.1 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY[3] ($X10$^{-6}$)** | | | | |
| Investment | - | 7.25 | 3.02 | 16.41 |
| Annual | - | -0.15 | 0.36 | 2.42 |

INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 5.5 | 2.2 | 0.2 | 0 |
| Oil and Grease | 509.0 | 4.7 | 0.5 | - |
| Total Suspended Solids | 13,175.0 | 22.9 | 2.3 | - |
| Total Toxic Metals | 91.0 | 0.2 | 0.02 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY[3] ($X10$^{-6}$)** | | | | |
| Investment | - | 0.97 | 0 | 5.44 |
| Annual | - | -0.03 | 0.14 | 0.67 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Raw waste loads for zero discharge plants have been included in these totals.

(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - SECTION
## CARBON

DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(2) WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 808.9 | 313.6 | 29.3 | 0 |
| Oil and Grease | 33,346.2 | 680.4 | 63.5 | - |
| Total Suspended Solids | 868,756.9 | 3,334.1 | 311.3 | - |
| Total Toxic Metals | 8,247.4 | 25.2 | 2.4 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X$10^{-6}$) | | | | |
| Investment | - | 108.01 | 58.53 | 319.92 |
| Annual | - | 1.52 | 8.80 | 58.25 |

INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 108.9 | 52.0 | 4.3 | 0 |
| Oil and Grease | 4,488.9 | 197.3 | 9.3 | - |
| Total Suspended Solids | 116,948.0 | 563.8 | 45.4 | - |
| Total Toxic Metals | 885.8 | 3.3 | 0.3 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X$10^{-6}$) | | | | |
| Investment | - | 14.12 | 10.05 | 43.61 |
| Annual | - | 0.18 | 1.55 | 7.90 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent warte loads.

(2) Raw waste loads for zero discharge plants have been included in these totals.

(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - SECTION
## SPECIALTY

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(2) WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 76.8 | 27.4 | 2.7 | 0 |
| Oil and Grease | 4,999.2 | 59.5 | 5.8 | - |
| Total Suspended Solids | 133,312.5 | 291.5 | 28.2 | - |
| Total Toxic Metals | 1,216.5 | 2.2 | 0.2 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$) | | | | |
| Investment | - | 17.44 | 6.26 | 41.54 |
| Annual | - | 0.14 | 0.87 | 6.56 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 3.8 | 1.6 | 0.2 | 0 |
| Oil and Grease | 250.0 | 3.5 | 0.3 | - |
| Total Suspended Solids | 6,665.6 | 17.2 | 1.7 | - |
| Total Toxic Metals | 60.8 | 0.1 | 0.01 | - |
| Total Organics | - | - | | |
| SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$) | | | | |
| Investment | - | 0.05 | 0.05 | 0.39 |
| Annual | - | -0.01 | 0.01 | 0.06 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Raw waste loads for the zero discharge plants have been included in these totals.

(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - FLAT
## HOT STRIP AND SHEET - CARBON

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 1,392.0 | 556.8 | 56.6 | 0 |
| Oil and Grease | 45,305.4 | 1,208.1 | 122.7 | - |
| Total Suspended Solids | 1,193,042.8 | 5,919.9 | 601.2 | - |
| Total Toxic Metals | 7,550.9 | 44.7 | 4.5 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 125.29 | 86.06 | 483.37 |
| Annual | - | -1.78 | 13.91 | 95.79 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 92.8 | 37.1 | 3.8 | 0 |
| Oil and Grease | 3,020.4 | 80.5 | 8.2 | - |
| Total Suspended Solids | 79,536.2 | 394.7 | 40.1 | - |
| Total Toxic Metals | 503.4 | 3.0 | 0.3 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 3.39 | 5.09 | 23.57 |
| Annual | - | -0.33 | 0.80 | 4.53 |

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - FLAT
## HOT STRIP AND SHEET - SPECIALTY

| | DIRECT DISCHARGERS | | | |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
| Flow (MGD) | 40.3 | 16.1 | 1.6 | 0 |
| Oil and Grease | 1,312.3 | 35.0 | 3.6 | - |
| Total Suspended Solids | 34,557.1 | 171.5 | 17.4 | - |
| Total Toxic Metals | 271.2 | 1.3 | 0.1 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$) | | | | |
| Investment | - | 5.19 | 5.40 | 22.58 |
| Annual | - | 0.25 | 0.80 | 3.71 |

---

Note: There are no indirect (POTW) discharges in this segment.

(1) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - FLAT
## PLATE - CARBON

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 117.8 | 47.1 | 4.9 | 0 |
| Oil and Grease | 7,157.5 | 102.2 | 10.5 | - |
| Total Suspended Solids | 191,718.1 | 501.0 | 51.6 | - |
| Total Toxic Metals | 1,789.4 | 3.8 | 0.4 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 20.15 | 11.72 | 58.97 |
| Annual | - | -0.36 | 1.76 | 8.03 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 10.7 | 4.3 | 0.4 | 0 |
| Oil and Grease | 650.7 | 9.3 | 1.0 | - |
| Total Suspended Solids | 17,428.9 | 45.6 | 4.7 | - |
| Total Toxic Metals | 162.7 | 0.3 | 0.04 | - |
| Total Organics | - | - | | |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 2.81 | 1.49 | 6.27 |
| Annual | - | 0.07 | 0.22 | 0.86 |

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### HOT FORMING - FLAT
### PLATE - SPECIALTY

| | DIRECT DISCHARGERS(1) | | | |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
| Flow (MGD) | 7.5 | 3.0 | 0.3 | 0 |
| Oil and Grease | 1,057.8 | 6.5 | 0.7 | - |
| Total Suspended Solids | 27,665.0 | 31.9 | 3.2 | - |
| Total Toxic Metals | 332.8 | 0.2 | 0.02 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(2) ($\$X10^{-6}$) | | | | |
| Investment | - | 3.19 | 2.11 | 8.28 |
| Annual | - | 0.10 | 0.30 | 1.18 |

---

Note: There are no indirect (POTW) dischargers in this segment.

(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - PIPE AND TUBE
## CARBON

DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 124.2 | 28.6 | 5.0 | 0 |
| Oil and Grease | 4,716.1 | 62.0 | 10.7 | - |
| Total Suspended Solids | 122,617.6 | 303.8 | 52.6 | - |
| Total Toxic Metals | 835.4 | 2.3 | 0.4 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$) | | | | |
| Investment | - | 22.11 | 13.38 | 72.59 |
| Annual | - | 2.64 | 1.87 | 11.81 |

INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 5.0 | 1.1 | 0.2 | 0 |
| Oil and Grease | 188.6 | 2.5 | 0.4 | - |
| Total Suspended Solids | 4,904.7 | 12.2 | 2.1 | - |
| Total Toxic Metals | 33.4 | 0.09 | 0.02 | 0 |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$) | | | | |
| Investment | - | 1.16 | 0.50 | 2.55 |
| Annual | - | 0.14 | 0.07 | 0.41 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT FORMING - PIPE AND TUBE
## SPECIALTY

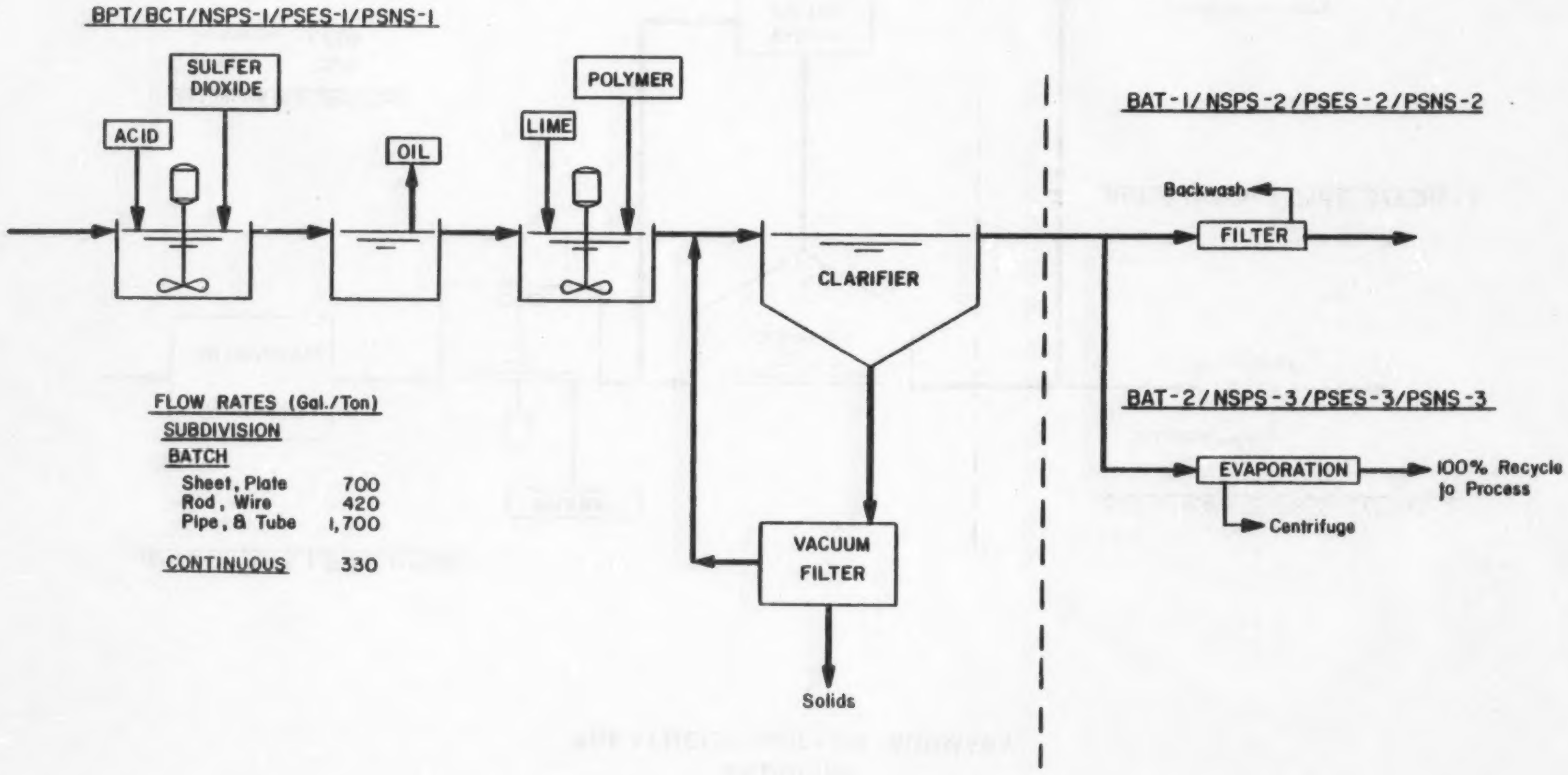
|  | DIRECT DISCHARGERS |  |  |  |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
| Flow (MGD) | 22.1 | 5.1 | 0.9 | 0 |
| Oil and Grease | 838.4 | 11.0 | 1.9 | - |
| Total Suspended Solids | 21,798.7 | 54.0 | 9.4 | - |
| Total Toxic Metals | 148.5 | 0.4 | 0.07 | - |
| Total Organics | - | - | - | - |
| SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$) |  |  |  |  |
| Investment | - | 3.68 | 1.73 | 13.32 |
| Annual | - | 0.27 | 0.24 | 2.03 |

---

Note: There are no indirect (POTW) dischargers in this segment.

(1) The cost summary totals do not include confidential plants.

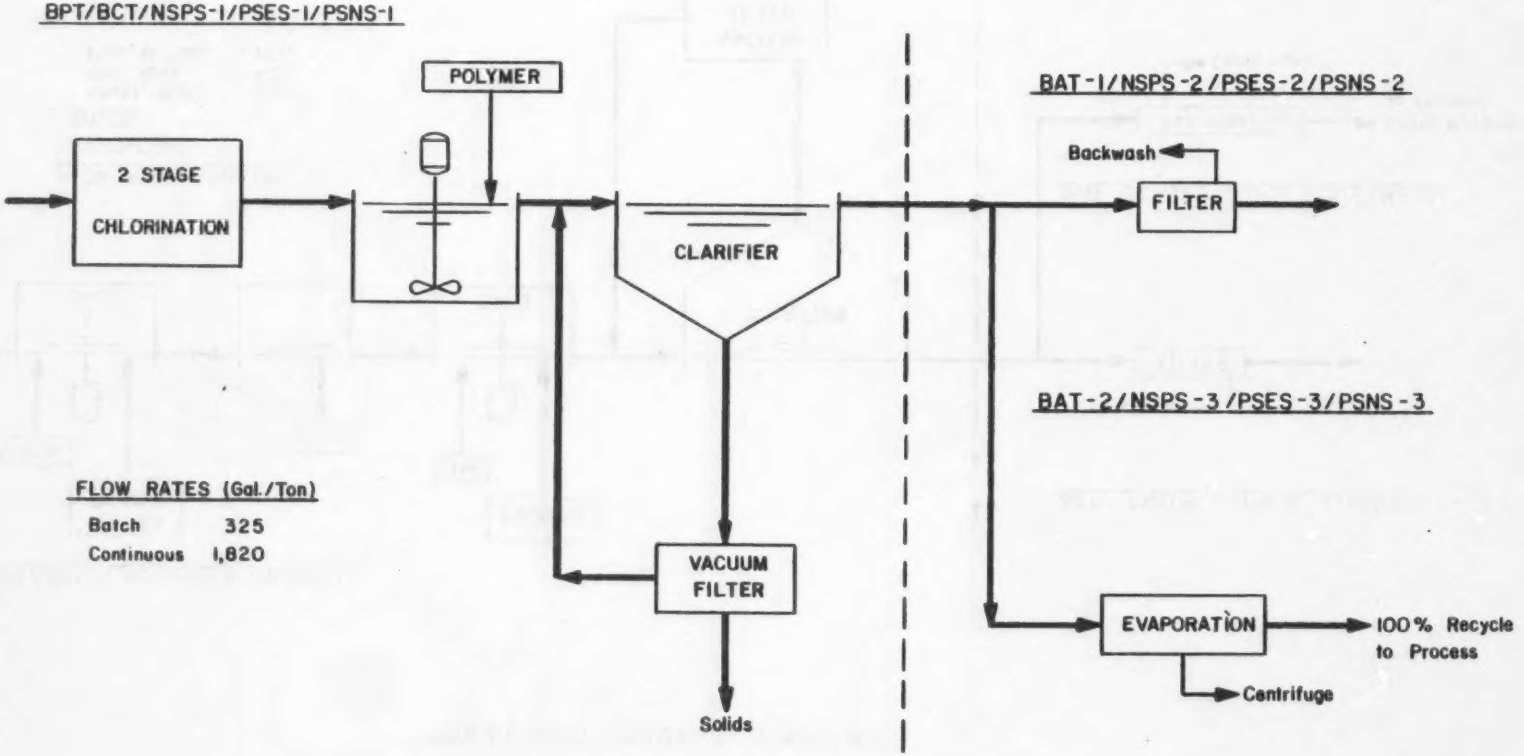
# SALT BATH DESCALING
# OXIDIZING
# TREATMENT MODELS SUMMARY



FLOW RATES (Gal./Ton)

| SUBDIVISION | |
|---|---|
| BATCH | |
| Sheet, Plate | 700 |
| Rod, Wire | 420 |
| Pipe, & Tube | 1,700 |
| CONTINUOUS | 330 |

# SALT BATH DESCALING
# REDUCING
# TREATMENT MODELS SUMMARY



**FLOW RATES (Gal./Ton)**

| | |
|---|---|
| Batch | 325 |
| Continuous | 1,820 |

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Salt Bath Descaling | MODEL SIZE (TPD): | 60 |
| : | Oxidizing | OPER. DAYS/YEAR : | 260 |
| : | Batch-Sheet/Plate | TURNS/DAY : | 2 |

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| Model Plant | | 0.04 MGD |
| 5 | Direct Dischargers | 0.2 MGD |
| 0 | Indirect Dischargers | 0 MGD |
| 5 | Active Plants | 0.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|
| Investment | 364 | 50.9 | 1984 |
| Annual | 53.9 | 6.8 | 285 |
| $/Ton of Production | 3.46 | 0.44 | 18.27 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|---|---|
| | Flow (GPT) | 700 | 700 | 700 | 0 |
| | pH (SU) | 11-13 | 6-9 | 6-9 | - |
| | Chromium (Hexavalent) | 200 | 0.05 | 0.05 | - |
| | Total Suspended Solids | 500 | (30)23.8 | (15)9.8 | - |
| 23 | Chloroform | 0.04 | 0.04 | 0.04 | - |
| 114 | Antimony | 0.2 | 0.1 | 0.1 | - |
| 115 | Arsenic* | 0.024 | 0.024 | 0.024 | - |
| 119 | Chromium* | 240 | (0.4)0.28 | (0.1)0.03 | - |
| 120 | Copper* | 1 | 0.04 | 0.03 | - |
| 123 | Mercury | 0.015 | 0.015 | 0.015 | - |
| 124 | Nickel | 7 | (0.3)0.25 | (0.1)0.04 | - |
| 125 | Selenium* | 0.024 | 0.024 | 0.024 | - |
| 127 | Thallium | 0.12 | 0.12 | 0.12 | - |
| 128 | Zinc | 0.1 | 0.06 | 0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS,PSES and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

*Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Salt Bath Descaling | MODEL SIZE (TPD): | 115 |
| : | Oxidizing | OPER. DAYS/YEAR : | 260 |
| : | Batch - Rod/Wire/Bar | TURNS/DAY : | 2 |

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 0.05 MGD |
| 3 Direct Dischargers | 0.1 MGD |
| 1 Indirect Dischargers | 0.05 MGD |
| 4 Active Plants | 0.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT NSPS-1 PSES-1 PSNS-1 | BAT-1 NSPS-2 PSES-2 PSNS-2 | BAT-2 NSPS-3 PSES-3 PSNS-3 |
|---|---|---|---|
| Investment | 387 | 54.9 | 2042 |
| Annual | 57.4 | 7.2 | 298 |
| $/Ton of Production | 1.92 | 0.24 | 9.97 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | BPT/BCT NSPS-1 PSES-1 PSNS-1 | BAT-1 NSPS-2 PSES-2 PSNS-2 | BAT-2 NSPS-3 PSES-3 PSNS-3 |
|---|---|---|---|---|---|
| | Flow (GPT) | 420 | 420 | 420 | 0 |
| | pH (SU) | 11-13 | 6-9 | 6-9 | - |
| | Chromium (Hexavalent) | 200 | 0.05 | 0.05 | - |
| | Total Suspended Solids | 500 | (30)23.8 | (15)9.8 | - |
| 23 | Chloroform | 0.04 | 0.04 | 0.04 | - |
| 114 | Antimony | 0.2 | 0.1 | 0.1 | - |
| 115 | Arsenic* | 0.024 | 0.024 | 0.024 | - |
| 119 | Chromium* | 240 | (0.4)0.28 | (0.1)0.03 | - |
| 120 | Copper* | 1 | 0.04 | 0.03 | - |
| 123 | Mercury | 0.015 | 0.015 | 0.015 | - |
| 124 | Nickel | 7 | (0.3)0.25 | (0.1)0.04 | - |
| 125 | Selenium* | 0.024 | 0.024 | 0.024 | - |
| 127 | Thallium | 0.12 | 0.12 | 0.12 | - |
| 128 | Zinc | 0.1 | 0.06 | 0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS, PSES and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Salt Bath Descaling
: Oxidizing
: Batch - Pipe and Tube

MODEL SIZE (TPD): 35
OPER. DAYS/YEAR : 260
TURNS/DAY : 2

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 0.06 MGD |
| 2 Direct Dischargers | 0.1 MGD |
| 0 Indirect Dischargers | 0 MGD |
| 2 Active Plants | 0.1 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|
| Investment | 435 | 62.5 | 2278 |
| Annual | 64.3 | 8.2 | 337 |
| $/Ton of Production | 7.07 | 0.90 | 37.03 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|---|---|
| | Flow (GPT) | 1700 | 1700 | 1700 | 0 |
| | pH (SU) | 11-13 | 6-9 | 6-9 | - |
| | Chromium (Hexavalent) | 200 | 0.05 | 0.05 | - |
| | Total Suspended Solids | 500 | (30)23.8 | (15)9.8 | - |
| 23 | Chloroform | 0.04 | 0.04 | 0.04 | - |
| 114 | Antimony | 0.2 | 0.1 | 0.1 | - |
| 115 | Arsenic* | 0.024 | 0.024 | 0.024 | - |
| 119 | Chromium* | 240 | (0.4)0.28 | (0.1)0.03 | - |
| 120 | Copper* | 1 | 0.04 | 0.03 | - |
| 123 | Mercury | 0.015 | 0.015 | 0.015 | - |
| 124 | Nickel | 7 | (0.3)0.25 | (0.1)0.04 | - |
| 125 | Selenium* | 0.024 | 0.024 | 0.024 | - |
| 127 | Thallium | 0.12 | 0.12 | 0.12 | - |
| 128 | Zinc | 0.1 | 0.06 | 0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS, PSES, and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Salt Bath Descaling | MODEL SIZE (TPD): | 140 |
| : | Oxidizing | OPER. DAYS/YEAR : | 260 |
| : | Continuous | TURNS/DAY : | 2 |

### RAW WASTE FLOWS

| | |
|---|---|
| Model Plant | 0.05 MGD |
| 7 Direct Dischargers | 0.3 MGD |
| 1 Indirect Dischargers | 0.05 MGD |
| 8 Active Plants | 0.4 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|
| Investment | 375 | 33.6 | 2042 |
| Annual | 55.7 | 7.0 | 296 |
| $/Ton of Production | 1.53 | 0.19 | 8.13 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|---|---|
| | Flow (GPT) | 330 | 330 | 330 | 0 |
| | pH (SU) | 11-13 | 6-9 | 6-9 | - |
| | Chromium (Hexavalent) | 200 | 0.05 | 0.05 | - |
| | Total Suspended Solids | 500 | (30)23.8 | (15)9.8 | - |
| 23 | Chloroform | 0.04 | 0.04 | 0.04 | - |
| 114 | Antimony | 0.2 | 0.1 | 0.1 | - |
| 115 | Arsenic* | 0.024 | 0.024 | 0.024 | - |
| 119 | Chromium* | 240 | (0.4)0.28 | (0.1)0.03 | - |
| 120 | Copper* | 1 | 0.04 | 0.03 | - |
| 123 | Mercury | 0.015 | 0.015 | 0.015 | - |
| 124 | Nickel | 7 | (0.3)0.25 | (0.1)0.04 | - |
| 125 | Selenium* | 0.024 | 0.024 | 0.024 | - |
| 127 | Thallium | 0.12 | 0.12 | 0.12 | - |
| 128 | Zinc | 0.1 | 0.06 | 0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES, PSNS and NSPS costs are incremental over BPT/PSES-1/PSNS-1/NSPS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Salt Bath Descaling | MODEL SIZE (TPD): | 130 |
| : | Reducing | OPER. DAYS/YEAR : | 260 |
| : | Batch | TURNS/DAY : | 3 |

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 0.04 MGD |
| 4 Direct Dischargers | 0.2 MGD |
| 1 Indirect Dischargers | 0.04 MGD |
| 5 Active Plants | 0.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|
| Investment | 291 | 39.6 | 1582 |
| Annual | 41.5 | 5.2 | 215 |
| $/Ton of Production | 1.23 | 0.15 | 6.36 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 |
|---|---|---|---|---|---|
| | Flow (GPT) | 325 | 325 | 325 | 0 |
| | pH (SU) | 11-12 | 6-9 | 6-9 | - |
| | Chromium (Hexavalent) | 0.26 | 0.05 | 0.05 | - |
| | Iron (Dissolved) | 12.4 | 1 | 0.5 | - |
| | Total Suspended Solids | 420 | (30)23.8 | (15)9.8 | - |
| 114 | Antimony* | 0.48 | 0.1 | 0.1 | - |
| 118 | Cadmium | 0.042 | 0.042 | 0.042 | - |
| 119 | Chromium* | 5.6 | (0.4)0.28 | (0.1)0.03 | - |
| 120 | Copper* | 0.4 | 0.04 | 0.03 | - |
| 121 | Cyanide | 0.038 | (0.25)0.038 | (0.25)0.038 | - |
| 122 | Lead* | 0.45 | 0.1 | 0.06 | - |
| 124 | Nickel* | 3 | (0.3)0.25 | (0.1)0.04 | - |
| 125 | Selenium* | 0.018 | 0.018 | 0.018 | - |
| 126 | Silver | 0.06 | 0.06 | 0.06 | - |
| 128 | Zinc* | 0.092 | 0.06 | 0.06 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES,PSNS and NSPS costs are incremental over BPT/PSES-1/PSNS-1/NSPS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Salt Bath Descaling
: Reducing
: Continuous

MODEL SIZE (TPD): 20
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

| RAW WASTE FLOWS | | |
|---|---|---|
| Model Plant | | 0.04 MGD |
| 2 | Direct Dischargers | 0.08 MGD |
| 0 | Indirect Dischargers | 0 MGD |
| 2 | Active Plants | 0.08 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT NSPS-1 PSES-1 PSNS-1 | BAT-1 NSPS-2 PSES-2 PSNS-2 | BAT-2 NSPS-3 PSES-3 PSNS-3 |
|---|---|---|---|
| Investment | 354 | 36.2 | 1582 |
| Annual | 48.8 | 4.9 | 212 |
| $/Ton of Production | 9.38 | 0.94 | 40.77 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT NSPS-1 PSES-1 PSNS-1 | BAT-1 NSPS-2 PSES-2 PSNS-2 | BAT-2 NSPS-3 PSES-3 PSNS-3 |
|---|---|---|---|---|---|
| | Flow (GPT) | 1820 | 1820 | 1820 | 0 |
| | pH (SU) | 11-12 | 6-9 | 6-9 | - |
| | Chromium (Hexavalent) | 0.26 | 0.05 | 0.05 | - |
| | Iron (Dissolved) | 12.4 | 1 | 0.5 | - |
| | Total Suspended Solids | 420 | (30)23.8 | (15)9.8 | - |
| 114 | Antimony* | 0.48 | 0.1 | 0.1 | - |
| 118 | Cadmium | 0.042 | 0.042 | 0.042 | - |
| 119 | Chromium* | 5.6 | (0.4)0.28 | (0.1)0.03 | - |
| 120 | Copper* | 0.4 | 0.04 | 0.03 | - |
| 121 | Cyanide | 0.038 | (0.25)0.038 | (0.25)0.038 | - |
| 122 | Lead* | 0.45 | 0.1 | 0.06 | - |
| 124 | Nickel* | 3 | (0.3)0.25 | (0.1)0.04 | - |
| 125 | Selenium* | 0.018 | 0.018 | 0.018 | - |
| 126 | Silver | 0.06 | 0.06 | 0.06 | - |
| 128 | Zinc* | 0.92 | 0.06 | 0.06 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS, PSES, and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS SALT BATH DESCALING SUBCATEGORY

| | DIRECT DISCHARGERS | | | |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
| Flow (MGD) | 1.0 | 1.0 | 1.0 | 0 |
| Dissolved Iron | 3.3 | 0.3 | 0.1 | - |
| Total Suspended Solids | 429.2 | 21.4 | 8.9 | - |
| Total Cyanide | (1) | (1) | (1) | - |
| Total Toxic Metals | 161.2 | 0.8 | 0.4 | - |
| Total Organics | (1) | (1) | (1) | - |
| SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$) | | | | |
| Investment | - | 4.92 | 0.92 | 35.23 |
| Annual | - | 0.73 | 0.11 | 5.05 |

| | INDIRECT (POTW) DISCHARGERS | | | |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
| Flow (MGD) | 0.1 | 0.1 | 0.1 | 0 |
| Dissolved Iron | 0.6 | (1) | (1) | - |
| Total Suspended Solids | 70.6 | 3.5 | 1.4 | - |
| Total Cyanide | (1) | (1) | (1) | - |
| Total Toxic Metals | 30.0 | 0.1 | (1) | - |
| Total Organics | (1) | (1) | (1) | - |
| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | | | |
| Investment | - | 1.19 | 0.26 | 9.52 |
| Annual | - | 0.18 | 0.04 | 1.37 |

---

(1) Load is less than 0.05 tons/year.
(2) Cost Summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## SALT BATH DESCALING SUBCATEGORY - OXIDIZING

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 0.8 | 0.8 | 0.8 | 0 |
| Total Suspended Solids | 319.0 | 15.2 | 6.3 | - |
| Total Toxic Metals | 158.5 | 0.6 | 0.3 | - |
| Total Organics | (1) | (1) | (1) | - |
| **SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$)** | | | | |
| Investment | - | 4.11 | 0.72 | 27.07 |
| Annual | - | 0.61 | 0.09 | 3.95 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 0.1 | 0.1 | 0.1 | 0 |
| Total Suspended Solids | 51.3 | 2.4 | 1.0 | - |
| Total Toxic Metals | 25.5 | 0.1 | (1) | - |
| Total Organics | (1) | (1) | (1) | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | |
| Investment | - | 1.08 | 0.24 | 8.90 |
| Annual | - | 0.16 | 0.04 | 1.29 |

---

(1) Load is less than 0.05 tons/year.
(2) The cost summary totals do not include confidential plants.

# SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## SALT BATH DESCALING SUBCATEGORY - REDUCING

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 0.2 | 0.2 | 0.2 | 0 |
| Dissolved Iron | 3.3 | 0.3 | 0.1 | - |
| Total Suspended Solids | 110.2 | 6.2 | 2.6 | - |
| Total Cyanide | (1) | (1) | (1) | - |
| Total Toxic Metals | 2.7 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 0.81 | 0.20 | 8.16 |
| Annual | - | 0.12 | 0.02 | 1.10 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 |
|---|---|---|---|---|
| Flow (MGD) | 0.04 | 0.04 | 0.04 | 0 |
| Dissolved Iron | 0.6 | (1) | (1) | - |
| Total Suspended Solids | 19.3 | 1.1 | 0.4 | - |
| Total Cyanide | (1) | (1) | (1) | - |
| Total Toxic Metals | 0.5 | (1) | (1) | - |
| Total Organics | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | |
| Investment | - | 0.11 | 0.02 | 0.62 |
| Annual | - | 0.02 | 0.002 | 0.08 |

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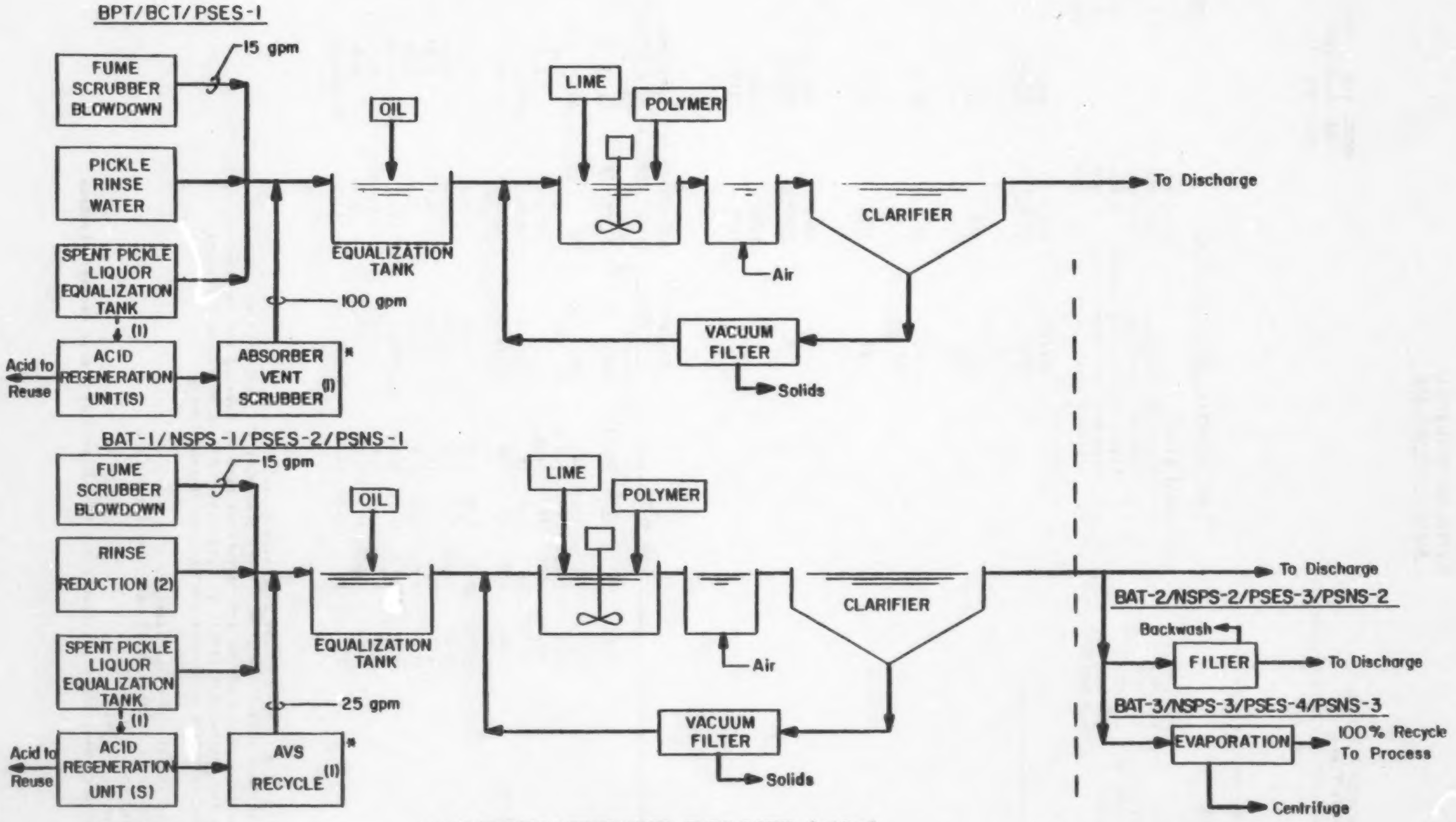
(1) Load is less than 0.05 tons/year.

# ACID PICKLING
# TREATMENT MODELS SUMMARY



(1) Hydrochloric Acid Regeneration Systems Only at BPT, BAT, BCT and PSES.

(2) Reduces Rinse Flows by 90%

* Replaces Spent Pickle Liquor Allowance for Hydrochloric Acid Regeneration System.

BPT/BCT/PSES-1 RINSEWATER FLOW RATES (gal/ton)

| | SULFURIC | HYDROCHLORIC | COMBINATION |
|---|---|---|---|
| ROD/WIRE/COIL | 260 | 480 | 490 |
| BAR/BILLET/BLOOM | 70 | — | 210 |
| PIPE/TUBE/OTHER | 480 | 1,010 | 750 |
| STRIP/SHEET/PLATE (Cont.) | 160 | 270 | 1,480 |
| STRIP/SHEET/PLATE (Batch) | — | — | 440 |
| SPENT PICKLE LIQUOR | 20 | 10 | 20 |

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## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

MODEL SIZE (TPD): 1660
OPER. DAYS/YEAR : 320
TURNS/DAY : 3

SUBCATEGORY: Sulfuric Acid Pickling
: Strip/Sheet/Plate
: Neutralization and Acid Recovery

### RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.3 MGD | Model Plant | 0.19 MGD | 9.6 MGD |
| 23 Direct Dischargers | 6.9 MGD | 14 Direct Dischargers | 2.7 MGD | 1.6 MGD |
| 4 Indirect Dischargers | 1.2 MGD | 2 Indirect Dischargers | 0.4 MGD | 0.3 MGD |
| 1 Plant Hauling All Wastes | 0.3 MGD | 0 Plants Hauling All Wastes | 0 MGD | 0.6 MGD |
| 2 Acid Recovery Plants | 0.6 MGD | 0 Acid Recovery Plants | 0 MGD | 12.1 MGD |
| 30 Active Plants | 9.0 MGD | 16 Active Plants | 3.1 MGD | |

### MODEL COSTS ($X10$^{-3}$)

| | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Neutralization | 1545 | 598 | 703 | 2969 |
| Acid Recovery | 3048 | - | - | - |
| Annual | | | | |
| Neutralization | 1060 | 74.7 | 88.4 | 441 |
| Acid Recovery | 567 | - | - | - |
| $/Ton of Production | | | | |
| Neutralization | 1.99 | 0.14 | 0.17 | 0.83 |
| Acid Recovery | 1.07 | - | - | - |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 |
|---|---|---|---|
| Investment | 1955 | 2060 | 4326 |
| Annual | 1106 | 1119 | 1472 |
| $/Ton of Production | 2.08 | 2.11 | 2.77 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT(2) PSES-1 | | BAT-1/PSES-2-1 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| Flow (GPT) | 20 | 160 | 135 | 342 | 180 | 15 | 40 | 15 | 40 | 15 | 0 |
| pH (SU) | <1-2 | <1-6.4 | <1-3 | <1-6.4 | 6-9 | | 6-9 | | 6-9 | | |
| Dissolved Iron | 49,000 | 3900 | 560 | 5600 | 1 | | 1 | | 0.5 | | - |
| Oil and Grease | 25 | 24 | 4.6 | 16 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| Total Suspended Solids | 2100 | 190 | 16 | 250 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 115 Arsenic* | 0.18 | 0.35 | 0.08 | 0.23 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 Cadmium | 0.33 | 0.032 | - | 0.04 | 0.04 | | 0.04 | | 0.04 | | - |
| 119 Chromium* | 170 | 6.4 | 1.1 | 15 | 0.04 | | 0.04 | | 0.03 | | - |
| 120 Copper* | 3.4 | 2.5 | 0.63 | 1.8 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 Lead* | 1.1 | 0.47 | 0.03 | 0.34 | (0.15)0.1 | | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 Nickel* | 24 | 2.5 | 1.6 | 3.6 | 0.15 | | 0.15 | | 0.04 | | - |
| 126 Silver | 0.44 | 0.016 | - | 0.04 | 0.04 | | 0.04 | | 0.04 | | - |
| 128 Zinc* | 50 | 13 | 0.29 | 10 | (0.1)0.06 | | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/1 unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/1 (maximum only).
- Concentration is less than 0.01 mg/1.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Rod/Wire/Coil
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 370
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

**RAW WASTE FLOWS**

| Rinses and Concentrates | | | Fume Scrubbers (Additional Flow) | | | Total Flow |
|---|---|---|---|---|---|---|
| Model Plant | | 0.10 MGD | Model Plant | | 0.19 MGD | |
| 16 | Direct Dischargers | 1.7 MGD | 2 | Direct Dischargers | 0.4 MGD | 2.1 MGD |
| 18 | Indirect Dischargers | 1.9 MGD | 2 | Indirect Dischargers | 0.4 MGD | 2.3 MGD |
| 2 | Plants Hauling All Wastes | 0.2 MGD | 0 | Plants Hauling All Wastes | 0 MGD | 0.2 MGD |
| 5 | Acid Recovery Plants | 0.5 MGD | 0 | Acid Recovery Plants | 0 MGD | 0.5 MGD |
| 41 | Active Plants | 4.3 MGD | 4 | Active Plants | 0.8 MGD | 5.1 MGD |

| MODEL COSTS ($X10$^{-3}$$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Neutralization | 1026 | 133 | 173 | 1715 |
| Acid Recovery | 1092 | - | - | - |
| Annual | | | | |
| Neutralization | 325 | 16.8 | 22.1 | 239 |
| Acid Recovery | 170 | - | - | - |
| $/Ton of Production | | | | |
| Neutralization | 3.38 | 0.17 | 0.23 | 2.48 |
| Acid Recovery | 1.77 | - | - | - |

| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
|---|---|---|---|
| Investment | 1033 | 1073 | 2615 |
| Annual | 324 | 329 | 546 |
| $/Ton of Production | 3.37 | 3.42 | 5.68 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT(2) PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 20 | 260 | 135 | 207 | 280 | 15 | 50 | 15 | 50 | 15 | 0 |
| | pH (SU) | <1-2 | <1-6.4 | <1-3 | <1-6.4 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 49,000 | 3,900 | 560 | 2,800 | 1 | | 1 | | 0.5 | | - |
| | Oil and Grease | 25 | 24 | 4.6 | 11 | (10)4.4 | | (10)4.4 | | (5**)2.0 | | - |
| | Total Suspended Solids | 2,100 | 190 | 16 | 120 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 115 | Arsenic* | 0.18 | 0.35 | 0.08 | 0.17 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.33 | 0.032 | - | 0.02 | 0.02 | | 0.02 | | 0.02 | | - |
| 119 | Chromium* | 170 | 6.4 | 1.1 | 6.9 | 0.04 | | 0.04 | | 0.03 | | - |
| 120 | Copper* | 3.4 | 2.5 | 0.63 | 1.3 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead* | 1.1 | 0.47 | 0.03 | 0.2 | (0.15)0.1 | | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 | Nickel* | 24 | 2.5 | 1.6 | 2.4 | 0.15 | | 0.15 | | 0.04 | | - |
| 126 | Silver | 0.44 | 0.016 | - | 0.02 | 0.02 | | 0.02 | | 0.02 | | - |
| 128 | Zinc* | 50 | 13 | 0.29 | 5.6 | (0.1)0.06 | | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease based upon mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Bar/Billet/Bloom
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 720
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

| Rinses and Concentrates | | | Fume Scrubbers (Additional Flow) | | | Total Flow |
|---|---|---|---|---|---|---|
| | Model Plant | 0.06 MGD | | Model Plant | 0.19 MGD | |
| 15 | Direct Dischargers | 1.0 MGD | 2 | Direct Dischargers | 0.2 MGD | 1.2 MGD |
| 3 | Indirect Dischargers | 0.2 MGD | 0 | Indirect Dischargers | 0 MGD | 0.2 MGD |
| 4 | Plants Hauling All Wastes | 0.3 MGD | 0 | Plants Hauling All Wastes | 0 MGD | 0.3 MGD |
| 0 | Acid Recovery Plants | 0 MGD | 0 | Acid Recovery Plants | 0 MGD | 0 MGD |
| 22 | Active Plants | 1.5 MGD | 2 | Active Plants | 0.2 MGD | 1.7 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Neutralization | 1122 | 259 | 305 | 1894 |
| Acid Recovery | 1744 | - | - | - |
| Annual | | | | |
| Neutralization | 407 | 32.5 | 38.5 | 268 |
| Acid Recovery | 283 | - | - | - |
| $/Ton of Production | | | | |
| Neutralization | 2.17 | 0.17 | 0.20 | 1.43 |
| Acid Recovery | 1.51 | - | - | - |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 |
|---|---|---|---|
| Investment | 1293 | 1339 | 2927 |
| Annaul | 428 | 434 | 663 |
| $/Ton of Production | 2.29 | 2.32 | 3.54 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT(2) PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| Flow (GPT) | 20 | 70 | 135 | 180 | 90 | 27 | 30 | 15 | 30 | 15 | 0 |
| pH (SU) | <1-2 | <1-6.4 | <1-3 | <1-6.4 | 6-9 | | 6-9 | | 6-9 | | |
| Dissolved Iron | 49,000 | 3900 | 560 | 3900 | 1 | | 1 | | 0.5 | | - |
| Oil and Grease | 25 | 24 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| Total Suspended Solids | 2100 | 190 | 16 | 170 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 115 Arsenic* | 0.18 | 0.35 | 0.08 | 0.14 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 Cadmium | 0.33 | 0.032 | - | 0.02 | 0.02 | | 0.02 | | 0.02 | | - |
| 119 Chromium* | 170 | 6.4 | 1.1 | 12 | 0.04 | | 0.04 | | 0.03 | | - |
| 120 Copper* | 3.4 | 2.5 | 0.63 | 1.1 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 Lead* | 1.1 | 0.47 | 0.03 | 0.18 | (0.15)0.1 | | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 Nickel* | 24 | 2.5 | 1.6 | 3.0 | 0.15 | | 0.15 | | 0.04 | | - |
| 126 Silver | 0.44 | 0.016 | - | 0.03 | 0.03 | | 0.03 | | 0.03 | | - |
| 128 Zinc* | 50 | 13 | 0.29 | 5.5 | (0.1)0.06 | | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-3 and PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Pipe/Tube/Other
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 220
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

**RAW WASTE FLOWS**

| Rinses and Concentrates | | | Fume Scrubbers (Additional Flow) | | | Total Flow |
|---|---|---|---|---|---|---|
| | Model Plant | 0.11 MGD | | Model Plant | 0.19 MGD | |
| 17 | Direct Dischargers | 1.9 MGD | 3 | Direct Dischargers | 0.6 MGD | 2.5 MGD |
| 9 | Indirect Dischargers | 1.0 MGD | 1 | Indirect Discharger | 0.2 MGD | 1.2 MGD |
| 4 | Plants Hauling All Wastes | 0.4 MGD | 0 | Plants Hauling All Wastes | 0 MGD | 0.4 MGD |
| 1 | Acid Recovery Plant | 0.1 MGD | 0 | Acid Recovery Plants | 0 MGD | 0.1 MGD |
| 31 | Active Plants | 3.4 MGD | 6 | Active Plants | 0.8 MGD | 4.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Neutralization | 971 | 79.2 | 121 | 1661 |
| Acid Recovery | 8[illegible] | - | - | - |
| Annual | | | | |
| Neutralization | 286 | 10.0 | 15.6 | 235 |
| Acid Recovery | 131 | - | - | - |
| $/Ton of Production | | | | |
| Neutralization | 5.00 | 0.17 | 0.27 | 4.11 |
| Acid Recovery | 2.29 | - | - | - |

| | PSNS-1<br>NSPS-1 | PSNS-2<br>NSPS-2 | PSNS-3<br>NSPS-3 |
|---|---|---|---|
| Investment | 918 | 960 | 2500 |
| Annual | 278 | 284 | 503 |
| $/Ton of Production | 4.86 | 4.96 | 8.79 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT[(2)]<br>PSES-1 | | BAT-1/PSES-2<br>NSPS-1/PSNS-1 | | BAT-2/PSES-3<br>NSPS-2/PSNS-2 | | BAT-3/PSES-4<br>NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 20 | 480 | 135 | 211 | 500 | 15 | 70 | 15 | 70 | 15 | 0 |
| | pH (SU) | <1-2 | <1-6.4 | <1-3 | <1-6.4 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 49,000 | 3900 | 560 | 2400 | 1 | | 1 | | 0.5 | | - |
| | Oil and Grease | 25 | 24 | 4.6 | 12 | (10)4.4 | | (10)4.4 | | (5**)2.0 | | - |
| | Total Suspended Solids | 2100 | 190 | 16 | 110 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 115 | Arsenic* | 0.18 | 0.35 | 0.08 | 0.17 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.33 | 0.032 | - | 0.02 | 0.02 | | 0.02 | | 0.02 | | - |
| 119 | Chromium* | 170 | 6.4 | 1.1 | 5.3 | 0.04 | | 0.04 | | 0.03 | | - |
| 120 | Copper* | 3.4 | 2.5 | 0.63 | 1.3 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead* | 1.1 | 0.47 | 0.03 | 0.2 | (0.15)0.1 | | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 | Nickel* | 24 | 2.5 | 1.6 | 2.2 | 0.15 | | 0.15 | | 0.04 | | - |
| 126 | Silver | 0.44 | 0.016 | - | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 128 | Zinc* | 50 | 13 | 0.29 | 5.4 | (0.1)0.06 | | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hydrochloric Acid Pickling
: Strip/Sheet/Plate
: Neutralization and Acid Regeneration

MODEL SIZE (TPD): 4020
OPER. DAYS/YEAR : 320
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | | Fume Scrubbers (Additional Flow) | | | Total Flow |
|---|---|---|---|---|---|---|
| Model Plant | | 1.13 MGD | Model Plant | | 0.19 MGD | |
| 21 | Direct Dischargers | 23.6 MGD | 20 | Direct Dischargers | 3.8 MGD | 27.4 MGD |
| 3 | Indirect Dischargers | 3.4 MGD | 2 | Indirect Dischargers | 0.4 MGD | 3.8 MGD |
| 4 | Acid Regeneration Plants | 4.5 MGD | 4 | Acid Regeneration Plants | 0.8 MGD | 5.3 MGD |
| 28 | Active Plants | 31.5 MGD | 26 | Active Plants | 5.0 MGD | 36.5 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Neutralization | 2231 | 1447 | 1608 | 4204 |
| Acid Regeneration | 5057 | 1592 | 1770 | 4645 |
| Annual | | | | |
| Neutralization | 1734 | 181 | 202 | 667 |
| Acid Regeneration | -765 | 202 | 225 | 751 |
| $/Ton of Production | | | | |
| Neutralization | 1.35 | 0.14 | 0.16 | 0.52 |
| Acid Regeneration | -0.59 | 0.16 | 0.17 | 0.58 |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 |
|---|---|---|---|
| Investment | 3189 | 3350 | 5946 |
| Annual | 1836 | 1857 | 2322 |
| $/Ton of Production | 1.43 | 1.44 | 1.80 |

SUBCATEGORY SUMMARY DATA
HYDROCHLORIC ACID PICKLING
STRIP/SHEET/PLATE
PAGE 2

| WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT PSES-1 | |
|---|---|---|---|---|---|---|
| | Conc | Rinse | FS(1) | Total(1) | Conc & Rinse | FS(1) |
| Flow (GPT) (Neutralization) | 10 | 270 | 135 | 917 | 280 | 15 |
| Flow (GPT) (Acid Regeneration) | 10 | 270 | 135 | 917 | 270 | 15 |
| pH (SU) | <1-5 | <1-5 | <1-3 | <1-5 | 6-9 | |
| Dissolved Iron | 73,000 | 1,700 | 560 | 3,700 | 1 | |
| Oil and Grease | 3.9 | 12 | 4.6 | 11 | (10)4.4 | |
| Total Suspended Solids | 400 | 45 | 16 | 52 | (30)23.8 | |
| 114 Antimony* | 2.2 | 0.2 | 0.6 | 0.32 | 0.1 | |
| 115 Arsenic* | 0.21 | 0.25 | 0.08 | 0.22 | 0.1 | |
| 118 Cadmium | 0.22 | - | 0.01 | 0.01 | 0.01 | |
| 119 Chromium* | 16 | 0.27 | 1.1 | 0.87 | 0.04 | |
| 120 Copper* | 16 | 0.63 | 0.63 | 1.1 | 0.04 | |
| 122 Lead* | 390 | 0.32 | 0.3 | 12 | (0.15)0.1 | |
| 124 Nickel* | 12 | 0.52 | 1.6 | 1.0 | 0.15 | |
| 128 Zinc* | 18 | 37 | 0.29 | 31 | (0.1)0.06 | |

| WASTEWATER CHARACTERISTICS | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|
| | Conc & Rinse | FS(1) | Conc & Rinse | FS(1) | |
| Flow (GPT) (Neutralization) | 40 | 15 | 40 | 15 | 0 |
| Flow (GPT) (Acid Regeneration) | 30 | 15 | 30 | 15 | 0 |
| pH (SU) | 6-9 | | 6-9 | | |
| Dissolved Iron | 1 | | 0.5 | | - |
| Oil and Grease | (10)4.4 | | (5**)2.0 | | - |
| Total Suspended Solids | (30)23.8 | | (15)9.8 | | - |
| 114 Antimony* | 0.1 | | 0.1 | | - |
| 115 Arsenic* | 0.1 | | 0.1 | | - |
| 118 Cadmium | 0.01 | | 0.01 | | - |
| 119 Chromium* | 0.04 | | 0.03 | | - |
| 120 Copper* | 0.04 | | 0.03 | | - |
| 122 Lead* | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 Nickel* | 0.15 | | 0.04 | | - |
| 128 Zinc* | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.
: The absorber vent scrubber flow only applies to acid regeneration systems. The flow is 100 GPM at the BPT treatment level. The AVS flow is reduced to 25 GPM at the BAT-1 and BAT-2 treatment levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hydrochloric Acid Pickling
: Rod/Wire/Coil
: Neutralization

MODEL SIZE (TPD): 90
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.04 MGD | Model Plant | 0.19 MGD | |
| 7 Direct Dischargers | 0.3 MGD | 4 Direct Dischargers | 0.8 MGD | 1.1 MGD |
| 8 Indirect Dischargers | 0.4 MGD | 3 Indirect Dischargers | 0.6 MGD | 1.0 MGD |
| 15 Active Plants | 0.7 MGD | 7 Active Plants | 1.4 MGD | 2.1 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 787 | 32.4 | 79.0 | 1932 |
| Annual | 190 | 4.1 | 10.2 | 274 |
| $/Ton of Production | 8.08 | 0.18 | 0.44 | 11.67 |
| | | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
| Investment | | 739 | 786 | 2638 |
| Annual | | 183 | 189 | 452 |
| $/Ton of Production | | 7.82 | 8.08 | 19.32 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 10 | 480 | 135 | 166 | 490 | 15 | 60 | 15 | 60 | 15 | 0 |
| | pH (SU) | <1-5 | <1-5 | <1-3 | <1-5 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 73,000 | 1,700 | 560 | 1,200 | 1 | | 1 | | 0.2 | | - |
| | Oil and Grease | 3.9 | 12 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)3.5 | | - |
| | Total Suspended Solids | 400 | 45 | 16 | 30 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 | Antimony* | 2.2 | 0.2 | 0.6 | 0.54 | 0.1 | 0.1 | 0.1 | | 0.1 | | - |
| 115 | Arsenic* | 0.21 | 0.25 | 0.08 | 0.11 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.22 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 | Chromium* | 16 | 0.27 | 1.1 | 1.0 | 0.04 | | 0.04 | | 0.03 | | - |
| 120 | Copper* | 16 | 0.63 | 0.63 | 0.72 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead* | 390 | 0.32 | 0.3 | 2.6 | (0.15)0.1 | | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 | Nickel* | 12 | 0.52 | 1.6 | 1.5 | 0.15 | | 0.15 | | 0.04 | | - |
| 128 | Zinc* | 18 | 37 | 0.29 | 7.0 | (0.1)0.06 | | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hydrochloric Acid Pickling
: Pipe/Tube
: Neutralization

MODEL SIZE (TPD): 110
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.11 MGD | Model Plant | 0.19 MGD | |
| 2 Direct Dischargers | 0.2 MGD | 1 Direct Discharger | 0.2 MGD | 0.4 MGD |
| 1 Indirect Discharger | 0.1 MGD | 0 Indirect Dischargers | 0 MGD | 0.1 MGD |
| 3 Active Plants | 0.3 MGD | 1 Active Plant | 0.2 MGD | 0.5 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 825 | 39.6 | 75.0 | 1621 |
| Annual | 174 | 5.1 | 9.8 | 223 |
| $/Ton of Production | 6.08 | 0.18 | 0.34 | 7.80 |
| | | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
| Investment | | 721 | 756 | 2302 |
| Annual | | 160 | 165 | 378 |
| $/Ton of Production | | 5.59 | 5.77 | 13.22 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 10 | 1010 | 135 | 213 | 1020 | 15 | 110 | 15 | 110 | 15 | 0 |
| | pH (SU) | <1-5 | <1-5 | <1-3 | <1-5 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 73,000 | 1,700 | 560 | 1,200 | 1 | | 1 | | 0.5 | | - |
| | Oil and Grease | 3.9 | 12 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2.0 | | - |
| | Total Suspended Solids | 400 | 45 | 16 | 30 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 | Antimony* | 2.2 | 0.2 | 0.6 | 0.46 | 0.1 | | 0.1 | | 0.1 | | - |
| 115 | Arsenic* | 0.21 | 0.25 | 0.08 | 0.14 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.22 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 | Chromium* | 16 | 0.27 | 1.1 | 1.0 | 0.04 | | 0.04 | | 0.03 | | - |
| 120 | Copper* | 16 | 0.63 | 0.63 | 0.69 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead* | 390 | 0.32 | 0.3 | 2.6 | (0.15)0.1 | | (0.15)0.1 | | (0.1)0.06 | | - |
| 124 | Nickel* | 12 | 0.52 | 1.6 | 1.5 | 0.15 | | 0.15 | | 0.04 | | - |
| 128 | Zinc* | 18 | 37 | 0.29 | 7.0 | (0.1)0.06 | | (0.1)0.06 | | (0.1)0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Batch Strip/Sheet/Plate

MODEL SIZE (TPD): 150
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

### RAW WASTE FLOWS

| | Rinses and Concentrates | | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|---|---|
| | Model Plant | 0.07 MGD | | Model Plant | 0.19 MGD | |
| 9 | Direct Dischargers | 0.6 MGD | 6 | Direct Dischargers | 1.1 MGD | 1.7 MGD |
| 0 | Indirect Dischargers | 0 MGD | 0 | Indirect Dischargers | 0 MGD | 0 MGD |
| 1 | Plant Hauling All Wastes | 0.1 MGD | 0 | Plants Hauling All Wastes | 0 MGD | 0.1 MGD |
| 10 | Active Plants | 0.7 MGD | 6 | Active Plants | 1.1 MGD | 1.8 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | 807 | 54.0 | 87.6 | 1574 |
| Annual | 188 | 6.9 | 11.4 | 216 |
| $/Ton of Production | 4.82 | 0.18 | 0.29 | 5.54 |
| | | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 |
| Investment | | 752 | 786 | 2272 |
| Annual | | 180 | 185 | 389 |
| $/Ton of Production | | 4.62 | 4.74 | 9.97 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 20 | 440 | 135 | 183 | 460 | 15 | 60 | 15 | 60 | 15 | 0 |
| | pH (SU) | <1-2.3 | 1.9-8.2 | <1-3 | <1-8.2 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 20,000 | 170 | 560 | 670 | 1 | | 1 | | 0.5 | | - |
| | Fluoride | 6100 | 170 | 1800 | 1400 | 15 | | 15 | | 15 | | - |
| | Oil and Grease | 2.1 | 4.6 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| | Total Suspended Solids | 140 | 93 | 16 | 37 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 | Antimony* | NA | 0.069 | 0.6 | 0.46 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.14 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 | Chromium* | 3500 | 37 | 1.1 | 48 | (0.4)0.28 | | (0.4)0.28 | | (0.1)0.03 | | - |
| 120 | Copper* | 170 | 1.2 | 0.63 | 2.6 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead | 2 | - | 0.03 | 0.04 | 0.04 | | 0.04 | | 0.04 | | - |
| 124 | Nickel* | 4600 | 37 | 1.6 | 61 | (0.3)0.25 | | (0.3)0.25 | | (0.1)0.04 | | - |
| 128 | Zinc* | 11 | 0.7 | 0.29 | 0.51 | 0.06 | | 0.06 | | 0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Batch Strip/Sheet/Plate

MODEL SIZE (TPD): 150
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | | Fume Scrubbers (Additional Flow) | | | Total Flow |
|---|---|---|---|---|---|---|
| | Model Plant | 0.07 MGD | | Model Plant | 0.19 MGD | |
| 9 | Direct Dischargers | 0.6 MGD | 6 | Direct Dischargers | 1.1 MGD | 1.7 MGD |
| 0 | Indirect Dischargers | 0 MGD | 0 | Indirect Dischargers | 0 MGD | 0 MGD |
| 1 | Plant Hauling All Wastes | 0.1 MGD | 0 | Plants Hauling All Wastes | 0 MGD | 0.1 MGD |
| 10 | Active Plants | 0.7 MGD | 6 | Active Plants | 1.1 MGD | 1.8 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 807 | 54.0 | 87.6 | 1574 |
| Annual | 188 | 6.9 | 11.4 | 216 |
| $/Ton of Production | 4.82 | 0.18 | 0.29 | 5.54 |
| | | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
| Investment | | 752 | 786 | 2272 |
| Annual | | 180 | 185 | 389 |
| $/Ton of Production | | 4.62 | 4.74 | 9.97 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 20 | 440 | 135 | 183 | 460 | 15 | 60 | 15 | 60 | 15 | 0 |
| | pH (SU) | <1-2.3 | 1.9-8.2 | <1-3 | <1-8.2 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 20,000 | 170 | 560 | 670 | 1 | | 1 | | 0.5 | | - |
| | Fluoride | 6100 | 170 | 1800 | 1400 | 15 | | 15 | | 15 | | - |
| | Oil and Grease | 2.1 | 4.6 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| | Total Suspended Solids | 140 | 93 | 16 | 37 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 | Antimony* | NA | 0.069 | 0.6 | 0.46 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.14 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 | Chromium* | 3500 | 37 | 1.1 | 48 | (0.4)0.28 | | (0.4)0.28 | | (0.1)0.03 | | - |
| 120 | Copper* | 170 | 1.2 | 0.63 | 2.6 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead | 2 | - | 0.03 | 0.04 | 0.04 | | 0.04 | | 0.04 | | - |
| 124 | Nickel* | 4600 | 37 | 1.6 | 61 | (0.3)0.25 | | (0.3)0.25 | | (0.1)0.04 | | - |
| 128 | Zinc* | 11 | 0.7 | 0.29 | 0.51 | 0.06 | | 0.06 | | 0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Continuous Strip/Sheet/Plate

MODEL SIZE (TPD): 600
OPER. DAYS/YEAR : 320
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.90 MGD | Model Plant | 0.19 MGD | |
| 14 Direct Dischargers | 12.6 MGD | 13 Direct Dischargers | 2.5 MGD | 15.1 MGD |
| 1 Indirect Discharger | 0.9 MGD | 1 Indirect Discharger | 0.2 MGD | 1.1 MGD |
| 15 Active Plants | 13.5 MGD | 14 Active Plants | 2.7 MGD | 16.2 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 1973 | 216 | 368 | 2823 |
| Annual | 697 | 27.1 | 47.0 | 482 |
| $/Ton of Production | 3.63 | 0.14 | 0.24 | 2.51 |
| | | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
| Investment | | 1742 | 1894 | 4350 |
| Annual | | 654 | 674 | 1109 |
| $/Ton of Production | | 3.41 | 3.51 | 5.78 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 20 | 1480 | 135 | 760 | 1500 | 15 | 170 | 15 | 170 | 15 | 0 |
| | pH (SU) | <1-2.3 | 1.9-8.2 | <1-3 | <1-8.2 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 20,000 | 170 | 560 | 450 | 1 | | 1 | | 0.5 | | - |
| | Fluoride | 6100 | 170 | 1800 | 520 | 15 | | 15 | | 15 | | - |
| | Oil and Grease | 2.1 | 4.6 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| | Total Suspended Solids | 140 | 93 | 16 | 80 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 | Antimony* | NA | 0.069 | 0.6 | 0.16 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.14 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 | Chromium* | 3500 | 37 | 1.1 | 67 | (0.4)0.28 | | (0.4)0.28 | | (0.1)0.03 | | - |
| 120 | Copper* | 170 | 1.2 | 0.63 | 2.9 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead | 2 | - | 0.03 | 0.03 | 0.03 | | 0.03 | | 0.03 | | - |
| 124 | Nickel* | 4600 | 37 | 1.6 | 79 | (0.3)0.25 | | (0.3)0.25 | | (0.1)0.04 | | - |
| 128 | Zinc* | 11 | 0.7 | 0.29 | 0.74 | 0.06 | | 0.06 | | 0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Rod/Wire/Coil

MODEL SIZE (TPD): 270
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.14 MGD | Model Plant | 0.19 MGD | |
| 9 Direct Dischargers | 1.2 MGD | 5 Direct Dischargers | 1.0 MGD | 2.2 MGD |
| 8 Indirect Dischargers | 1.1 MGD | 5 Indirect Dischargers | 1.0 MGD | 2.1 MGD |
| 17 Active Plants | 2.3 MGD | 10 Active Plants | 2.0 MGD | 4.3 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | 977 | 97.2 | 140 | 1679 |
| Annual | 256 | 12.2 | 17.8 | 238 |
| $/Ton of Production | 3.65 | 0.17 | 0.25 | 3.39 |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 |
|---|---|---|---|
| Investment | 930 | 973 | 2512 |
| Annual | 248 | 254 | 474 |
| $/Ton of Production | 3.53 | 3.62 | 6.75 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| Flow (GPT) | 20 | 490 | 135 | 231 | 510 | 15 | 70 | 15 | 70 | 15 | 0 |
| pH (SU) | <1-2.3 | 1.9-8.2 | <1-3 | <1-8.2 | 6-9 | | 6-9 | | 6-9 | | |
| Dissolved Iron | 20,000 | 170 | 560 | 740 | 1 | | 1 | | 0.5 | | - |
| Fluoride | 6100 | 170 | 1800 | 1200 | 15 | | 15 | | 15 | | - |
| Oil and Grease | 2.1 | 4.6 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| Total Suspended Solids | 140 | 93 | 16 | 49 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 Antimony* | NA | 0.069 | 0.6 | 0.38 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 Cadmium | 0.14 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 Chromium* | 3500 | 37 | 1.1 | 76 | (0.4)0.28 | | (0.4)0.28 | | (0.1)0.03 | | - |
| 120 Copper* | 170 | 1.2 | 0.63 | 3.8 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 Lead | 2 | - | 0.03 | 0.05 | 0.05 | | 0.05 | | 0.05 | | - |
| 124 Nickel* | 4600 | 37 | 1.6 | 95 | (0.3)0.25 | | (0.3)0.25 | | (0.1)0.04 | | - |
| 128 Zinc* | 11 | 0.7 | 0.29 | 0.64 | 0.06 | | 0.06 | | 0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Bar/Billet/Bloom

MODEL SIZE (TPD): 60
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.01 MGD | Model Plant | 0.19 MGD | |
| 3 Direct Dischargers | 0.04 MGD | 1 Direct Discharger | 0.2 MGD | 0.24 MGD |
| 1 Indirect Discharger | 0.01 MGD | 0 Indirect Dischargers | 0 MGD | 0.01 MGD |
| 1 Plant Hauling All Wastes | 0.01 MGD | 0 Plants Hauling All Wastes | 0 MGD | 0.01 MGD |
| 5 Active Plants | 0.06 MGD | 1 Active Plant | 0.2 MGD | 0.26 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 669 | 21.6 | 53.3 | 1500 |
| Annual | 164 | 2.8 | 7.0 | 205 |
| $/Ton of Production | 10.51 | 0.18 | 0.45 | 13.14 |

| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 |
|---|---|---|---|
| Investment | 672 | 704 | 2151 |
| Annual | 164 | 168 | 366 |
| $/Ton of Production | 10.51 | 10.77 | 23.46 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| | Flow (GPT) | 20 | 210 | 135 | 145 | 230 | 15 | 40 | 15 | 40 | 15 | 0 |
| | pH (SU) | <1-2.3 | 1.9-8.2 | <1-3 | <1-8.2 | 6-9 | | 6-9 | | 6-9 | | |
| | Dissolved Iron | 20,000 | 170 | 560 | 670 | 1 | | 1 | | 0.5 | | - |
| | Fluoride | 6100 | 170 | 1800 | 1700 | 15 | | 15 | | 15 | | - |
| | Oil and Grease | 2.1 | 4.6 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| | Total Suspended Solids | 140 | 93 | 16 | 25 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 | Antimony* | NA | 0.069 | 0.6 | 0.57 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 | Cadmium | 0.14 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 | Chromium* | 3500 | 37 | 1.1 | 27 | (0.4)0.28 | | (0.4)0.28 | | (0.1)0.03 | | - |
| 120 | Copper* | 170 | 1.2 | 0.63 | 1.8 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 | Lead | 2 | - | 0.03 | 0.04 | 0.04 | | 0.04 | | 0.04 | | - |
| 124 | Nickel* | 4600 | 37 | 1.6 | 36 | (0.3)0.25 | | (0.3)0.25 | | (0.1)0.04 | | - |
| 128 | Zinc* | 11 | 0.7 | 0.29 | 0.39 | 0.06 | | 0.06 | | 0.06 | | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Pipe/Tube

MODEL SIZE (TPD): 60
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

### RAW WASTE FLOWS

| Rinses and Concentrates | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.05 MGD | Model Plant | 0.19 MGD | |
| 11 Direct Dischargers | 0.5 MGD | 3 Direct Dischargers | 0.6 MGD | 1.1 MGD |
| 8 Indirect Dischargers | 0.4 MGD | 3 Indirect Dischargers | 0.6 MGD | 1.0 MGD |
| 1 Plant Hauling All Wastes | 0.05 MGD | 0 Plants Hauling All Wastes | 0 MGD | 0.05 MGD |
| 20 Active Plants | 0.95 MGD | 6 Active Plants | 1.2 MGD | 2.15 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 719 | 21.6 | 55.2 | 1542 |
| Annual | 173 | 2.8 | 7.3 | 212 |
| $/Ton of Production | 11.09 | 0.18 | 0.47 | 13.59 |
| | | **NSPS-1<br>PSNS-1** | **NSPS-2<br>PSNS-2** | **NSPS-3<br>PSNS-3** |
| Investment | | 686 | 719 | 2206 |
| Annual | | 169 | 173 | 377 |
| $/Ton of Production | | 10.83 | 11.09 | 24.17 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | | | BPT/BCT PSES-1 | | BAT-1/PSES-2 NSPS-1/PSNS-1 | | BAT-2/PSES-3 NSPS-2/PSNS-2 | | BAT-3/PSES-4 NSPS-3/PSNS-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Conc | Rinse | FS (1) | Total (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | Conc & Rinse | FS (1) | |
| Flow (GPT) | 20 | 750 | 135 | 167 | 770 | 15 | 100 | 15 | 100 | 15 | 0 |
| pH (SU) | <1-2.3 | 1.9-8.2 | <1-3 | <1-8.2 | 6-9 | | 6-9 | | 6-9 | | |
| Dissolved Iron | 20,000 | 170 | 560 | 580 | 1 | | 1 | | 0.5 | | - |
| Fluoride | 6100 | 170 | 1800 | 1500 | 15 | | 15 | | 15 | | - |
| Oil and Grease | 2.1 | 4.6 | 4.6 | 10 | (10)4.4 | | (10)4.4 | | (5**)2 | | - |
| Total Suspended Solids | 140 | 93 | 16 | 31 | (30)23.8 | | (30)23.8 | | (15)9.8 | | - |
| 114 Antimony* | NA | 0.069 | 0.6 | 0.5 | 0.1 | | 0.1 | | 0.1 | | - |
| 118 Cadmium | 0.14 | - | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | | - |
| 119 Chromium* | 3500 | 37 | 1.1 | 25 | (0.4)0.28 | | (0.4)0.28 | | (0.1)0.03 | | - |
| 120 Copper* | 170 | 1.2 | 0.63 | 1.5 | 0.04 | | 0.04 | | 0.03 | | - |
| 122 Lead | 2 | - | 0.03 | 0.03 | 0.03 | | 0.03 | | 0.03 | | - |
| 124 Nickel* | 4600 | 37 | 1.6 | 30 | (0.3)0.25 | | (0.3)0.25 | | (0.1)0.04 | | - |
| 128 Zinc* | 11 | 0.7 | 0.29 | 0.42 | 0.06 | | 0.06 | | 0.06 | | - |

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Notes: All concentrations are in mg/1 unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/1 (maximum only).
- Concentration is less than 0.01 mg/1.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## ACID PICKLING - ALL SUBDIVISIONS
## ALL PRODUCTS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(1)(2) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 72.5 | 58.4 | 9.8 | 9.8 | 0 |
| Dissolved Iron | 277,873.5 | 75.8 | 12.6 | 6.4 | - |
| Fluoride | 18,512.6 | 302.4 | 44.7 | 44.7 | - |
| Oil and Grease | 1,070.8 | 342.1 | 56.1 | 26.6 | - |
| Total Suspended Solids | 8,688.1 | 1,803.7 | 303.9 | 125.2 | - |
| Total Toxic Metals | 6,384.5 | 48.4 | 8.0 | 4.9 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) (\$X10$^{-6}$)** | | | | | |
| Investment | - | 150.06 | 64.62 | 76.91 | 362.69 |
| Annual | - | 54.22 | 7.93 | 9.56 | 55.32 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 14.2 | 10.7 | 2.1 | 2.1 | 0 |
| Dissolved Iron | 45,495.0 | 13.1 | 2.5 | 1.3 | - |
| Fluoride | 5,035.1 | 45.5 | 8.5 | 8.5 | - |
| Oil and Grease | 192.4 | 58.1 | 10.8 | 4.7 | - |
| Total Suspended Solids | 1,554.2 | 314.3 | 58.7 | 24.1 | - |
| Total Toxic Metals | 1,053.9 | 8.1 | 1.4 | 0.9 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) (\$X10$^{-6}$)** | | | | | |
| Investment | - | 24.88 | 5.48 | 7.15 | 63.20 |
| Annual | - | 9.26 | 0.68 | 0.91 | 9.04 |

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(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### SULFURIC ACID PICKLING SUBCATEGORY
### STRIP/SHEET/PLATE: NEUTRALIZATION AND ACID RECOVERY

#### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW[(1)(2)] WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 10.5 | 7.8 | 1.8 | 1.8 | 0 |
| Dissolved Iron | 78,438.0 | 10.4 | 2.4 | 1.2 | - |
| Oil and Grease | 224.1 | 45.7 | 10.7 | 4.9 | - |
| Total Suspended Solids | 3,501.7 | 247.0 | 58.1 | 23.9 | - |
| Total Toxic Metals | 434.9 | 5.9 | 1.4 | 1.0 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$)** | | | | | |
| Investment | - | 26.71 | 13.52 | 15.90 | 67.16 |
| Annual | - | 14.91 | 1.69 | 2.00 | 9.98 |

#### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.6 | 1.2 | 0.3 | 0.3 | 0 |
| Dissolved Iron | 11,843.8 | 1.6 | 0.4 | 0.2 | - |
| Oil and Grease | 33.8 | 7.3 | 1.8 | 0.8 | - |
| Total Suspended Solids | 528.7 | 39.4 | 9.8 | 4.0 | - |
| Total Toxic Metals | 65.7 | 0.9 | 0.2 | 0.2 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 2.55 | 0.90 | 1.06 | 4.47 |
| Annual | - | 1.59 | 0.11 | 0.13 | 0.66 |

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(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## SULFURIC ACID PICKLING SUBCATEGORY
## ROD/WIRE/COIL: NEUTRALIZATION AND ACID RECOVERY

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(1)(2) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 2.8 | 2.2 | 0.3 | 0.3 | 0 |
| Dissolved Iron | 8,419.0 | 2.4 | 0.4 | 0.2 | - |
| Oil and Grease | 33.1 | 10.6 | 1.6 | 0.7 | - |
| Total Suspended Solids | 360.8 | 57.3 | 8.8 | 3.6 | - |
| Total Toxic Metals | 49.9 | 1.3 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 17.23 | 2.08 | 2.70 | 26.75 |
| Annual | - | 4.08 | 0.26 | 0.34 | 3.73 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 2.2 | 1.9 | 0.4 | 0.4 | 0 |
| Dissolved Iron | 6,845.5 | 2.1 | 0.4 | 0.2 | - |
| Oil and Grease | 26.9 | 9.1 | 1.8 | 0.8 | - |
| Total Suspended Solids | 293.4 | 49.3 | 9.7 | 4.0 | - |
| Total Toxic Metals | 40.6 | 1.1 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 6.87 | 1.19 | 1.55 | 15.56 |
| Annual | - | 2.21 | 0.15 | 0.20 | 2.17 |

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(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## SULFURIC ACID PICKLING SUBCATEGORY
## BAR/BILLET/BLOOM: NEUTRALIZATION AND ACID RECOVERY

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(1) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.6 | 1.0 | 0.4 | 0.4 | 0 |
| Dissolved Iron | 6,854.1 | 1.1 | 0.4 | 0.2 | - |
| Oil and Grease | 17.6 | 4.8 | 1.8 | 0.8 | - |
| Total Suspended Solids | 298.8 | 26.2 | 9.5 | 3.9 | - |
| Total Toxic Metals | 38.6 | 0.6 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 9.88 | 3.34 | 3.93 | 24.38 |
| Annual | - | 2.93 | 0.42 | 0.50 | 3.45 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.2 | 0.2 | 0.06 | 0.06 | 0 |
| Dissolved Iron | 822.5 | 0.2 | 0.1 | (2) | - |
| Oil and Grease | 2.1 | 0.9 | 0.3 | 0.1 | - |
| Total Suspended Solids | 35.8 | 5.0 | 1.7 | 0.7 | - |
| Total Toxic Metals | 4.6 | 0.1 | (2) | (2) | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 1.71 | 0.46 | 0.54 | 3.35 |
| Annual | - | 0.65 | 0.06 | 0.07 | 0.48 |

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(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Load is less than or equal to 0.05 ton/year.
(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## SULFURIC ACID PICKLING SUBCATEGORY
## PIPE/TUBE/OTHER: NEUTRALIZATION AND ACID RECOVERY

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(1)(2) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 3.0 | 2.0 | 0.3 | 0.3 | 0 |
| Dissolved Iron | 7,819.2 | 2.2 | 0.4 | 0.2 | - |
| Oil and Grease | 39.1 | 9.8 | 1.6 | 0.7 | - |
| Total Suspended Solids | 358.4 | 52.8 | 8.4 | 3.5 | - |
| Total Toxic Metals | 47.6 | 1.2 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) ($$X10^{-6}$)** | | | | | |
| Investment | - | 8.74 | 1.39 | 2.12 | 29.08 |
| Annual | - | 2.11 | 0.17 | 0.27 | 4.12 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.2 | 1.0 | 0.2 | 0.2 | 0 |
| Dissolved Iron | 3,083.8 | 1.1 | 0.2 | 0.1 | - |
| Oil and Grease | 15.4 | 4.8 | 0.8 | 0.3 | - |
| Total Suspended Solids | 141.3 | 26.1 | 4.1 | 1.7 | - |
| Total Toxic Metals | 18.8 | 0.6 | 0.1 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(3) ($$X10^{-6}$)** | | | | | |
| Investment | - | 2.05 | 0.29 | 0.44 | 6.04 |
| Annual | - | 0.60 | 0.04 | 0.06 | 0.86 |

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(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HYDROCHLORIC ACID PICKLING SUBCATEGORY
## STRIP/SHEET/PLATE: NEUTRALIZATION AND ACID REGENERATION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 32.6 | 29.1 | 4.5 | 4.5 | 0 |
| Dissolved Iron | 161,273.1 | 38.8 | 6.0 | 3.0 | - |
| Oil and Grease | 479.5 | 170.8 | 26.6 | 12.1 | - |
| Total Suspended Solids | 2,266.5 | 923.9 | 143.7 | 59.2 | - |
| Total Toxic Metals | 2,027.7 | 23.3 | 3.6 | 2.6 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 52.46 | 39.22 | 43.45 | 111.88 |
| Annual | - | 19.46 | 4.76 | 5.33 | 17.63 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 3.8 | 3.4 | 0.5 | 0.5 | 0 |
| Dissolved Iron | 18,603.0 | 4.6 | 0.7 | 0.4 | - |
| Oil and Grease | 55.3 | 20.1 | 3.1 | 1.4 | - |
| Total Suspended Solids | 261.4 | 108.7 | 16.7 | 6.9 | - |
| Total Toxic Metals | 233.9 | 2.7 | 0.4 | 0.3 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 1.76 | 1.86 | 2.07 | 5.41 |
| Annual | - | 1.60 | 0.23 | 0.26 | 0.86 |

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HYDROCHLORIC ACID PICKLING SUBCATEGORY
## ROD/WIRE/COIL: NEUTRALIZATION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.1 | 0.4 | 0.1 | 0.1 | 0 |
| Dissolved Iron | 1,414.2 | 0.4 | 0.1 | 0.1 | - |
| Oil and Grease | 11.8 | 1.9 | 0.6 | 0.3 | - |
| Total Suspended Solids | 35.4 | 10.2 | 3.2 | 1.3 | - |
| Total Toxic Metals | 15.9 | 0.3 | 0.1 | 0.1 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 3.86 | 0.18 | 0.51 | 10.92 |
| Annual | - | 0.78 | 0.02 | 0.06 | 1.55 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.9 | 0.4 | 0.1 | 0.1 | 0 |
| Dissolved Iron | 1,218.5 | 0.4 | 0.1 | 0.1 | - |
| Oil and Grease | 10.2 | 2.0 | 0.5 | 0.2 | - |
| Total Suspended Solids | 30.5 | 10.8 | 2.8 | 1.1 | - |
| Total Toxic Metals | 13.7 | 0.3 | 0.1 | 0.1 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 4.70 | 0.25 | 0.62 | 15.04 |
| Annual | - | 1.15 | 0.03 | 0.08 | 2.13 |

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(1) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HYDROCHLORIC ACID PICKLING SUBCATEGORY
## PIPE/TUBE: NEUTRALIZATION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.4 | 0.2 | 0.05 | 0.05 | 0 |
| Dissolved Iron | 545.2 | 0.3 | (1) | (1) | - |
| Oil and Grease | 4.5 | 1.2 | 0.2 | 1.0 | - |
| Total Suspended Solids | 13.6 | 6.4 | 1.2 | 0.5 | - |
| Total Toxic Metals | 6.1 | 0.2 | (1) | (1) | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY(2) ($X10$^{-6}$)** | | | | | |
| Investment | - | 0.96 | 0.07 | 0.13 | 2.80 |
| Annual | - | 0.21 | 0.009 | 0.02 | 0.38 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.1 | 0.1 | 0.01 | 0.01 | 0 |
| Dissolved Iron | 146.1 | 0.1 | (1) | (1) | - |
| Oil and Grease | 1.2 | 0.5 | 0.1 | (1) | - |
| Total Suspended Solids | 3.6 | 2.9 | 0.3 | 0.1 | - |
| Total Toxic Metals | 1.6 | 0.1 | (1) | (1) | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 0.03 | 0.001 | 0.003 | 0.06 |
| Annual | - | 0.006 | 0.0002 | 0.0003 | 0.008 |

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(1) Load is less than or equal to 0.05 ton/year.
(2) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COMBINATION ACID PICKLING SUBCATEGORY
## BATCH STRIP/SHEET/PLATE: NEUTRALIZATION

| | DIRECT DISCHARGERS | | | | |
|---|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW[1] WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
| Flow (MGD) | 1.9 | 0.8 | 0.2 | 0.2 | 0 |
| Dissolved Iron | 1,349.3 | 0.8 | 0.2 | 0.1 | - |
| Fluoride | 2,819.5 | 12.2 | 3.4 | 3.4 | - |
| Oil and Grease | 20.1 | 3.6 | 1.0 | 0.5 | - |
| Total Suspended Solids | 74.5 | 19.4 | 5.4 | 2.2 | - |
| Total Toxic Metals | 226.8 | 0.6 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$) | | | | | |
| Investment | - | 3.21 | 0.42 | 0.68 | 12.16 |
| Annual | - | 0.74 | 0.05 | 0.09 | 1.66 |

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(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) The cost summary totals do not include confidential plants.

Note: There are no POTW dischargers in this segment.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COMBINATION ACID PICKLING SUBCATEGORY
## CONTINUOUS STRIP/SHEET/PLATE: NEUTRALIZATION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 15.1 | 12.9 | 1.7 | 1.7 | 0 |
| Dissolved Iron | 9,089.0 | 17.2 | 2.3 | 1.1 | - |
| Fluoride | 10,502.9 | 258.0 | 34.2 | 34.2 | - |
| Oil and Grease | 202.0 | 75.7 | 10.0 | 4.6 | - |
| Total Suspended Solids | 1,615.8 | 409.3 | 54.3 | 22.4 | - |
| Total Toxic Metals | 3,026.4 | 13.2 | 1.8 | 0.7 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 17.57 | 3.14 | 5.36 | 41.09 |
| Annual | - | 6.56 | 0.39 | 0.68 | 7.02 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.1 | 0.9 | 0.1 | 0.1 | 0 |
| Dissolved Iron | 657.6 | 1.2 | 0.2 | 0.1 | - |
| Fluoride | 759.8 | 18.5 | 2.5 | 2.5 | - |
| Oil and Grease | 14.6 | 5.4 | 0.7 | 0.3 | - |
| Total Suspended Solids | 116.9 | 29.3 | 3.9 | 1.6 | - |
| Total Toxic Metals | 219.0 | 0.9 | 0.1 | (1) | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 0.35 | 0.04 | 0.07 | 0.50 |
| Annual | - | 0.12 | 0.005 | 0.008 | 0.09 |

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(1) Load is less than or equal to 0.05 ton/year.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COMBINATION ACID PICKLING SUBCATEGORY
## ROD/WIRE/COIL: NEUTRALIZATION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 2.2 | 1.3 | 0.3 | 0.3 | 0 |
| Dissolved Iron | 1,775.2 | 1.5 | 0.3 | 0.2 | - |
| Fluoride | 2,878.7 | 21.9 | 4.5 | 4.5 | - |
| Oil and Grease | 24.0 | 6.4 | 1.3 | 0.6 | - |
| Total Suspended Solids | 117.5 | 34.8 | 7.2 | 3.0 | - |
| Total Toxic Metals | 421.9 | 1.2 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 5.84 | 0.99 | 1.44 | 17.09 |
| Annual | - | 1.55 | 0.12 | 0.18 | 3.14 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 2.1 | 1.2 | 0.3 | 0.3 | 0 |
| Dissolved Iron | 1,664.7 | 1.3 | 0.3 | 0.1 | - |
| Fluoride | 2,699.4 | 19.7 | 4.2 | 4.2 | - |
| Oil and Grease | 22.5 | 5.8 | 1.2 | 0.6 | - |
| Total Suspended Solids | 110.2 | 31.2 | 6.7 | 2.8 | - |
| Total Toxic Metals | 395.6 | 1.0 | 0.2 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 3.20 | 0.41 | 0.59 | 7.08 |
| Annual | - | 0.87 | 0.05 | 0.08 | 1.00 |

# SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
# COMBINATION ACID PICKLING SUBCATEGORY
# BAR/BILLET/BLOOM: NEUTRALIZATION

## DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(1) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.2 | 0.06 | 0.03 | 0.03 | 0 |
| Dissolved Iron | 181.4 | 0.1 | (2) | (2) | - |
| Fluoride | 460.3 | 1.0 | 0.5 | 0.5 | - |
| Oil and Grease | 2.7 | 0.3 | 0.1 | 0.1 | - |
| Total Suspended Solids | 6.8 | 1.6 | 0.7 | 0.3 | - |
| Total Toxic Metals | 17.8 | 0.1 | (2) | (2) | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($\$X10^{-6}$) | | | | | |
| Investment | - | 0.60 | 0.06 | 0.16 | 4.54 |
| Annual | - | 0.20 | 0.008 | 0.02 | 0.62 |

## INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.01 | 0.01 | 0.002 | 0.002 | 0 |
| Dissolved Iron | 10.0 | (2) | (2) | (2) | - |
| Fluoride | 25.4 | 0.2 | (2) | (2) | - |
| Oil and Grease | 0.1 | 0.1 | (2) | (2) | - |
| Total Suspended Solids | 0.4 | 0.4 | 0.1 | (2) | - |
| Total Toxic Metals | 1.0 | (2) | (2) | (2) | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) | | | | | |
| Investment | - | 0.56 | 0.04 | 0.10 | 2.72 |
| Annual | - | 0.18 | 0.005 | 0.01 | 0.37 |

---

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.

(2) Load is less than or equal to 0.05 ton/year.

(3) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COMBINATION ACID PICKLING SUBCATEGORY
## PIPE/TUBE: NEUTRALIZATION

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(1) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.1 | 0.6 | 0.1 | 0.1 | 0 |
| Dissolved Iron | 715.8 | 0.6 | 0.1 | 0.1 | - |
| Fluoride | 1,851.2 | 9.3 | 2.1 | 2.1 | - |
| Oil and Grease | 12.3 | 2.7 | 0.6 | 0.3 | - |
| Total Suspended Solids | 38.3 | 14.8 | 3.4 | 1.4 | - |
| Total Toxic Metals | 70.9 | 0.5 | 0.1 | (2) | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$) | | | | | |
| Investment | - | 3.00 | 0.21 | 0.53 | 14.84 |
| Annual | - | 0.69 | 0.03 | 0.07 | 2.04 |

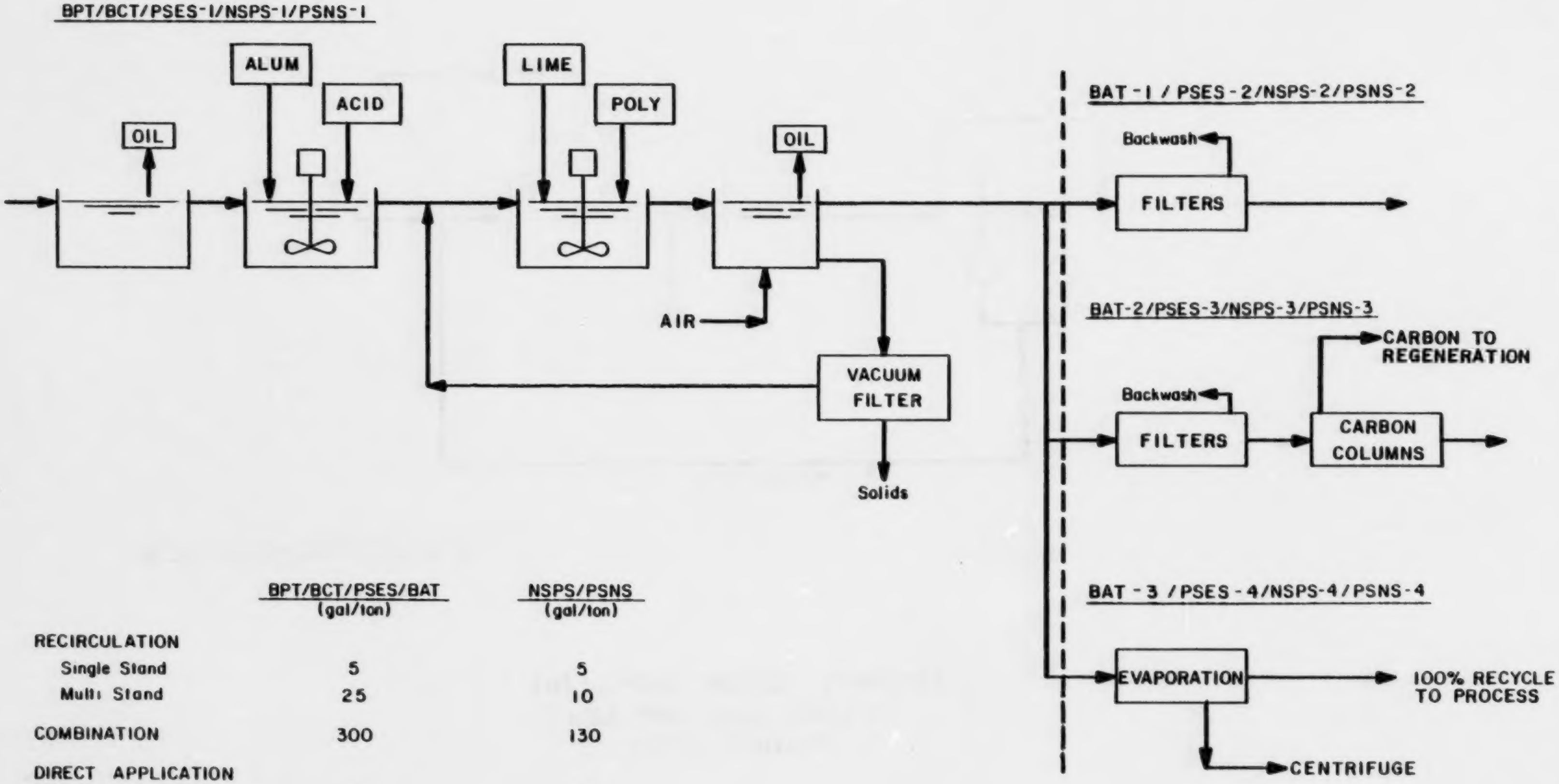
### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.0 | 0.4 | 0.1 | 0.1 | 0 |
| Dissolved Iron | 599.5 | 0.5 | 0.1 | 0.1 | - |
| Fluoride | 1,550.5 | 7.1 | 1.8 | 1.8 | - |
| Oil and Grease | 10.3 | 2.1 | 0.5 | 0.2 | - |
| Total Suspended Solids | 32.0 | 11.2 | 2.9 | 1.2 | - |
| Total Toxic Metals | 59.4 | 0.4 | 0.1 | (2) | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY(3) ($X10$^{-6}$) | | | | | |
| Investment | - | 1.10 | 0.04 | 0.11 | 2.97 |
| Annual | - | 0.28 | 0.005 | 0.01 | 0.41 |

---

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Load is less than or equal to 0.05 ton/year.
(3) The cost summary totals do not include confidential plants.

# COLD FORMING: COLD ROLLING
# TREATMENT MODELS SUMMARY



| | BPT/BCT/PSES/BAT (gal/ton) | NSPS/PSNS (gal/ton) |
|---|---|---|
| RECIRCULATION | | |
| Single Stand | 5 | 5 |
| Multi Stand | 25 | 10 |
| COMBINATION | 300 | 130 |
| DIRECT APPLICATION | | |
| Single Stand | 90 | 25 |
| Multi Stand | 400 | 290 |

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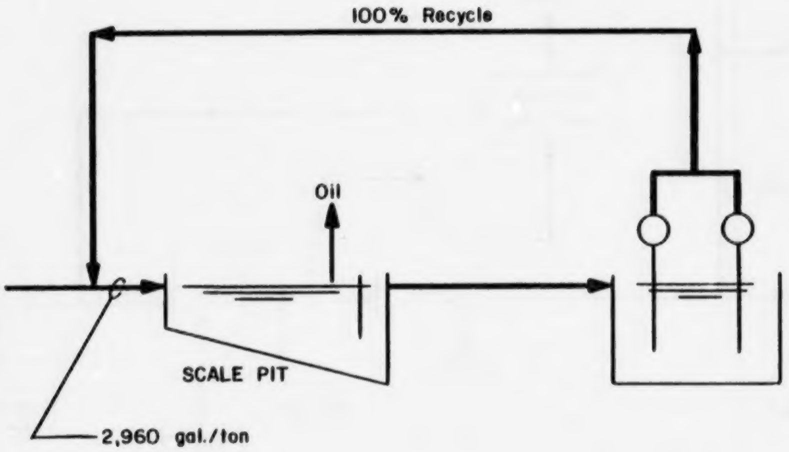
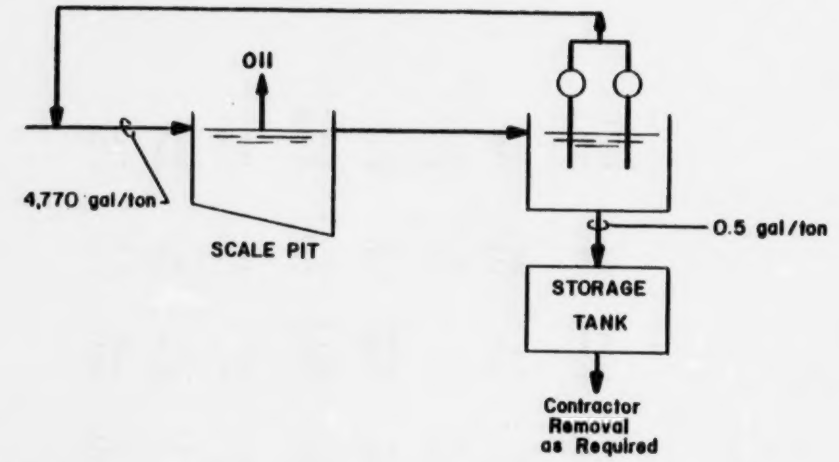
# COLD FORMING
# PIPE AND TUBE (WATER)
# TREATMENT MODEL SUMMARY

BPT/BAT/BCT/PSES/PSNS/NSPS

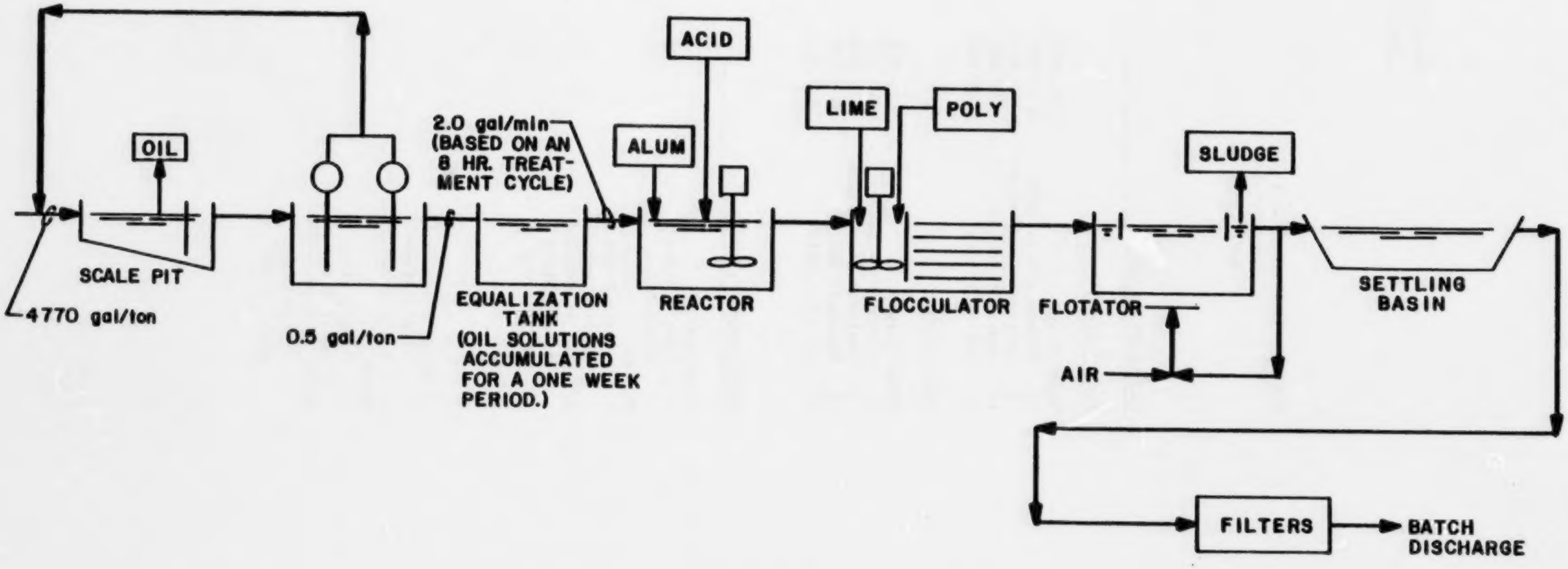


# COLD FORMING
# PIPE AND TUBE (SOLUBLE OIL)
# TREATMENT MODELS SUMMARY

BPT/BAT/BCT/PSES/PSNS-1/NSPS-1



PSNS-2/NSPS-2



## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Cold Forming
: Cold Rolling
: Recirculation

| | SINGLE STAND | MULTI STAND |
|---|---|---|
| MODEL SIZE (TPD): | 450 | 2400 |
| OPER. DAYS/YEAR : | 348 | 348 |
| TURNS/DAY : | 3 | 3 |

### RAW WASTE FLOWS

**Single Stand**

| | | |
|---|---|---|
| Model Plant | | 0.002 MGD |
| 13 | Direct Dischargers | 0.03 MGD |
| 3 | Indirect Dischargers | 0.006 MGD |
| 10 | Contract Hauled | 0.02 MGD |
| 26 | Active Plants | 0.06 MGD |

**Multi Stand**

| | | |
|---|---|---|
| Model Plant | | 0.06 MGD |
| 21 | Direct Dischargers | 1.3 MGD |
| 3 | Indirect Dischargers | 0.2 MGD |
| 3 | Contract Hauled | 0.2 MGD |
| 27 | Active Plants | 1.7 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Single Stand | 208 | 8.0 | 184 | 538 |
| Multi Stand | 494 | 49.5 | 1142 | 1946 |
| Annual | | | | |
| Single Stand | 29.9 | 1.3 | 24.2 | 75.0 |
| Multi Stand | 55.0 | 6.7 | 147 | 291 |
| $/Ton of Production | | | | |
| Single Stand | 0.19 | 0.008 | 0.15 | 0.48 |
| Multi Stand | 0.066 | 0.008 | 0.18 | 0.35 |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 | NSPS-4 PSNS-4 |
|---|---|---|---|---|
| Investment | | | | |
| Single Stand | 208 | 216 | 392 | 746 |
| Multi Stand | 361 | 390 | 1,024 | 1,840 |
| Annual | | | | |
| Single Stand | 29.9 | 31.2 | 54.1 | 105 |
| Multi Stand | 43.6 | 47.5 | 129 | 242 |
| $/Ton of Production | | | | |
| Single Stand | 0.19 | 0.20 | 0.35 | 0.67 |
| Multi Stand | 0.052 | 0.057 | 0.15 | 0.29 |

SUBCATEGORY SUMMARY DATA
COLD FORMING-RECIRCULATION
PAGE 2

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-4<br>PSES-4<br>PSNS-4 |
|---|---|---|---|---|---|---|
| | Flow (GPT) Single Stand | 5 [5] | 5 [5] | 5 [5] | 5 [5] | 0 |
| | Flow (GPT) Multi Stand | 25 [10] | 25 [10] | 25 [10] | 25 [10] | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 14700 | (10)7 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 1013 | (30)16 | (15)9.8 | (15)9.8 | - |
| 1 | Acenaphthene | 0.055 | 0.01 | 0.01 | 0.01 | - |
| 11 | 1,1,1-Trichloroethane | 0.063 | 0.063 | 0.063 | 0.063 | - |
| 13 | 1,1-Dichloroethane | 0.011 | 0.011 | 0.011 | 0.011 | - |
| 23 | Chloroform | 0.037 | 0.002 | 0.002 | 0.002 | - |
| 39 | Fluoranthene | 0.27 | 0.01 | 0.01 | 0.01 | - |
| 55 | Naphthalene | 1.5 | (0.1***)0.012 | (0.1***)0.012 | (0.02)0.012 | - |
| 60 | 4,6-Dinitro-o-cresol | 0.063 | 0.063 | 0.025 | 0.025 | - |
| 65 | Phenol | 0.17 | 0.093 | 0.093 | 0.05 | - |
| 72 | Benzo (a) Anthracene | 0.16 | 0.005 | 0.005 | 0.005 | - |
| 76 | Chrysene | 0.11 | 0.001 | 0.001 | 0.001 | - |
| 77 | Acenaphthylene | 0.14 | 0.01 | 0.01 | 0.01 | - |
| 78 | Anthracene | 0.14 | 0.01 | 0.01 | 0.01 | - |
| 80 | Fluorene | 3.5 | 0.01 | 0.01 | 0.01 | - |
| 81 | Phenanthrene | 0.91 | 0.01 | 0.01 | 0.01 | - |
| 84 | Pyrene | 0.30 | 0.005 | 0.005 | 0.005 | - |
| 85 | Tetrachloroethylene | 0.036 | (0.15***)0.035 | (0.15***)0.035 | (0.15***)0.035 | - |
| 86 | Toluene | 0.012 | 0.004 | 0.004 | 0.004 | - |
| 87 | Trichloroethylene | 0.009 | 0.002 | 0.002 | 0.002 | - |
| 114 | Antimony* | 0.031 | 0.031 | 0.031 | 0.031 | - |
| 115 | Arsenic* | 0.26 | 0.1 | 0.05 | 0.05 | - |
| 118 | Cadmium* | 0.11 | 0.016 | 0.016 | 0.016 | - |
| 119 | Chromium* | 2.5 | (0.4)0.28 | (0.1)0.03 | (0.1)0.03 | - |
| 120 | Copper* | 7.1 | 0.1 | 0.03 | 0.03 | - |
| 122 | Lead* | 2.9 | (0.15)0.1 | (0.1)0.06 | (0.1)0.06 | - |
| 124 | Nickel* | 3.3 | (0.3)0.2 | (0.1)0.04 | (0.1)0.04 | - |
| 128 | Zinc* | 3.7 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for various levels of treatment. All other values represent long term average values or predicted average performance levels.
: Values in brackets represent NSPS/PSNS flows.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
*** Maximum limit only.
PSNS/NSPS flow

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Cold Forming
: Cold Rolling
: Combination

MODEL SIZE (TPD): 4800
OPER. DAYS/YEAR : 348
TURNS/DAY : 3

RAW WASTE FLOWS

| | | |
|---|---|---|
| | Model Plant | 1.4 MGD |
| 10 | Direct Dischargers | 14.0 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 10 | Active Plants | 14.0 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | 1540 | 561 | 3988 | 12298 |
| Annual | 299 | 77.9 | 553 | 2470 |
| $/Ton of Production | 0.18 | 0.047 | 0.33 | 1.48 |

| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 | NSPS-4<br>PSNS-4 |
|---|---|---|---|---|
| Investment | 1182 | 1652 | 3731 | 6920 |
| Annual | 202 | 266 | 533 | 1386 |
| $/Ton of Production | 0.12 | 0.16 | 0.32 | 0.83 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-4<br>PSES-4<br>PSNS-4 |
|---|---|---|---|---|---|---|
| | Flow (GPT) | 300 [130] | 300 [130] | 300 [130] | 300 [130] | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 1481 | (10)7 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 843 | (30)16 | (15)9.8 | (15)9.8 | - |
| 39 | Fluoranthene | 0.071 | 0.01 | 0.01 | 0.01 | - |
| 55 | Naphthalene | 4 | (0.1***)0.012 | (0.1***)0.012 | (0.1***)0.012 | - |
| 78 | Anthracene | 0.18 | 0.01 | 0.01 | 0.01 | - |
| 80 | Fluorene | 0.98 | 0.01 | 0.01 | 0.01 | - |
| 81 | Phenanthrene | 5.1 | 0.01 | 0.01 | 0.01 | - |
| 84 | Pyrene | 0.05 | 0.005 | 0.005 | 0.005 | - |
| 85 | Tetrachlorothylene | 0.02 | (0.15***)0.02 | (0.15***)0.02 | (0.15***)0.02 | - |
| 115 | Arsenic* | 0.16 | 0.1 | 0.05 | 0.05 | - |
| 119 | Chromium* | 0.03 | (0.4)0.03 | (0.1)0.03 | (0.1)0.03 | - |
| 120 | Copper* | 0.89 | 0.1 | 0.03 | 0.03 | - |
| 122 | Lead | 0.1 | (0.15)0.1 | (0.1)0.06 | (0.1)0.06 | - |
| 124 | Nickel* | 0.21 | (0.3)0.2 | (0.1)0.04 | (0.1)0.04 | - |
| 128 | Zinc* | 0.15 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for various levels of treatment. All other values represent long term average values or predicted average performance levels.
: Values in brackets represent NSPS/PSNS flows.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
*** Maximum limit only
NSPS/PSNS flow

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

**SUBCATEGORY:** Cold Forming
: Cold Rolling
: Direct Application

| | SINGLE STAND | MULTI STAND |
|---|---|---|
| MODEL SIZE (TPD): | 2000 | 2700 |
| OPER. DAYS/YEAR : | 348 | 348 |
| TURNS/DAY : | 3 | 3 |

**RAW WASTE FLOWS**

**Single Stand**

| | | |
|---|---|---|
| Model Plant | | 0.2 MGD |
| 9 | Direct Dischargers | 1.8 MGD |
| 0 | Indirect Dischargers | 0 MGD |
| 1 | Contract Hauled | 0.2 MGD |
| 10 | Active Plants | 2.0 MGD |

**Multi Stand**

| | | |
|---|---|---|
| Model Plant | | 1.1 MGD |
| 10 | Direct Dischargers | 11.0 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 1 | Contract Hauled | 1.1 MGD |
| 11 | Active Plants | 12.1 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Single Stand | 714 | 153 | 2057 | 2633 |
| Multi Stand | 1216 | 539 | 3367 | 7887 |
| Annual | | | | |
| Single Stand | 102 | 20.1 | 264 | 461 |
| Multi Stand | 206 | 75.3 | 468 | 1842 |
| $/Ton of Production | | | | |
| Single Stand | 0.15 | 0.029 | 0.38 | 0.66 |
| Multi Stand | 0.22 | 0.080 | 0.50 | 1.96 |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 | NSPS-4 PSNS-4 |
|---|---|---|---|---|
| Investment | | | | |
| Single Stand | 432 | 476 | 1456 | 2014 |
| Multi Stand | 1111 | 1651 | 3983 | 7670 |
| Annual | | | | |
| Single Stand | 62.4 | 68.4 | 194 | 290 |
| Multi Stand | 184 | 256 | 557 | 1548 |
| $/Ton of Production | | | | |
| Single Stand | 0.09 | 0.10 | 0.28 | 0.42 |
| Multi Stand | 0.20 | 0.27 | 0.59 | 1.65 |

SUBCATEGORY SUMMARY DATA
COLD FORMING-DIRECT APPLICATION
PAGE 2

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>NSPS-1<br>PSES-1<br>PSNS-1 | BAT-1<br>NSPS-2<br>PSES-2<br>PSNS-2 | BAT-2<br>NSPS-3<br>PSES-3<br>PSNS-3 | BAT-3<br>NSPS-4<br>PSES-4<br>PSNS-4 |
|---|---|---|---|---|---|---|
| | Flow (GPT) Single Stand | 90 [25] | 90 [25] | 90 [25] | 90 [25] | 0 |
| | Flow (GPT) Multi Stand | 400 [290] | 400 [290] | 400 [290] | 400 [290] | 0 |
| | pH (SU) | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Oil and Grease | 1215 | (10)7 | (5**)2.0 | (5**)2.0 | - |
| | Total Suspended Solids | 135 | (30)16 | (15)9.8 | (15)9.8 | - |
| 6 | Carbon Tetrachloride | 0.007 | 0.007 | 0.007 | 0.007 | - |
| 11 | 1,1,1-Trichloroethane | 0.043 | 0.043 | 0.043 | 0.043 | - |
| 55 | Napthalene | 4.4 | (0.1***)0.012 | (0.1***)0.012 | (0.1***)0.012 | |
| 78 | Anthracene | 0.014 | 0.01 | 0.01 | 0.01 | - |
| 85 | Tetrachloroethylene | 0.02 | (0.15***)0.02 | (0.15***)0.02 | (0.15***)0.02 | - |
| 86 | Toluene | 0.69 | 0.004 | 0.004 | 0.004 | - |
| 115 | Arsenic | 0.02 | 0.02 | 0.02 | 0.02 | - |
| 117 | Beryllium | 0.01 | 0.006 | 0.006 | 0.006 | - |
| 119 | Chromium | 0.04 | (0.4)0.04 | (0.1)0.03 | (0.1)0.03 | - |
| 120 | Copper* | 0.17 | 0.1 | 0.03 | 0.03 | - |
| 122 | Lead | 0.39 | (0.15)0.1 | (0.1)0.06 | (0.1)0.06 | - |
| 124 | Nickel* | 0.2 | (0.3)0.2 | (0.1)0.04 | (0.1)0.04 | - |
| 128 | Zinc | 0.098 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/1 unless otherwise noted.
: BPT and PSES-2 through PSES-4 are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the proposed limitations/standards. All other values represent long term average values or predicted average performance levels.
: Values in brackets represent NSPS/PSNS flows.

* Toxic pollutant found in all raw waste samples analyzed.
** Limit for oil and grease is based upon 10 mg/1 (maximum only).
*** Maximum limit only.
NSPS/PSNS flow

# SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Cold Forming | MODEL SIZE (TPD): | 500 |
| : | Cold Worked Pipe and Tube | OPER. DAYS/YEAR : | 260 |
| : | Using Water | TURNS/DAY : | 3 |

| RAW WASTE FLOWS | | |
|---|---|---|
| Model Plant | | 1.5 MGD |
| 9 | Direct Dischargers | 13.3 MGD |
| 2 | Indirect Dischargers | 3.0 MGD |
| 4 | Zero Dischargers | 5.9 MGD |
| 15 | Active Plants | 22.2 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT BAT NSPS PSES PSNS |
|---|---|
| Investment | 498 |
| Annual | 64.5 |
| $/Ton of Production | 0.50 |

| WASTEWATER CHARACTERISTICS | | RAW WASTE | BPT/BCT BAT NSPS PSES PSNS |
|---|---|---|---|
| | Flow (GPT) | 2960 | 0 |
| | pH (SU) | 6-9 | - |
| | Oil and Grease | 65 | - |
| | Total Suspended Solids | 25 | - |
| 120 | Copper | 0.07 | - |
| 124 | Nickel | 0.025 | - |
| 128 | Zinc | 0.23 | - |

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Note: All concentrations are in mg/l unless otherwise noted.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Cold Forming | MODEL SIZE (TPD): | 270 |
| : | Cold Worked Pipe and Tube | OPER. DAYS/YEAR : | 260 |
| : | Using Oil | TURNS/DAY : | 3 |

| RAW WASTE FLOWS | | |
|---|---|---|
| Model Plant | | 1.3 MGD |
| 1 | Direct Discharger | 1.3 MGD |
| 0 | Indirect Dischargers | 0.0 MGD |
| 15 | Plants Hauling Waste Solutions | 19.3 MGD |
| 2 | Zero Dischargers | 2.6 MGD |
| 1 | Other Discharger | 1.3 MGD |
| 19 | Active Plants | 24.5 MGD |

| MODEL COSTS ($X10$^{-3}$) | BPT/BCT<br>BAT<br>NSPS-1<br>PSES ·<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|
| Investment | 424 | 665 |
| Annual | 55.6 | 87.2 |
| $/Ton of Production | 0.79 | 1.24 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT<br>BAT<br>NSPS-1<br>PSES<br>PSNS-1 | NSPS-2<br>PSNS-2 |
|---|---|---|---|---|
| | Flow (GPT) | 4770 | 0 | 0.5 |
| | pH (SU) | 6-9 | - | 6-9 |
| | Oil and Grease | 10% | - | 2 |
| | Total Suspended Solids | 1000 | - | 9.8 |
| 39 | Fluoranthene | 0.049 | - | 0.01 |
| 65 | Phenol | 0.016 | - | 0.016 |
| 72 | Benzo (a) Anthracene | 0.018 | - | 0.005 |
| 78 | Anthracene | 0.38 | - | 0.1 |
| 80 | Fluorene | 0.04 | - | 0.01 |
| 84 | Pyrene | 0.079 | - | 0.005 |
| 85 | Tetrachloroethylene | 0.078 | - | 0.05 |
| 86 | Toluene | 0.015 | - | 0.015 |
| 87 | Trichloroethylene | 0.092 | - | 0.092 |
| 119 | Chromium | 0.42 | - | 0.03 |
| 120 | Copper | 2 | - | 0.03 |
| 122 | Lead | 0.36 | - | 0.06 |
| 124 | Nickel | 0.51 | - | 0.04 |
| 128 | Zinc | 5 | - | 0.10 |

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Notes: All concentrations are in mg/l unless otherwise noted.
: All values represent long-term average values or predicted average performance levels.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COLD FORMING SUBCATEGORY

### DIRECT DISCHARGERS(1)

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 73.3 | 28.1 | 28.1 | 28.1 | 0 |
| Oil and Grease | 2,742,937.8 | 285.8 | 81.7 | 81.7 | - |
| Total Suspended Solids | 44,570.5 | 653.0 | 400.0 | 400.0 | - |
| Total Toxic Metals | 320.6 | 21.4 | 9.8 | 9.8 | - |
| Total Organics | 356.9 | 4.1 | 4.0 | 3.8 | - |
| SUBCATEGORY COST SUMMARY(2) (\$$\mathrm{X}10^{-6}$) | | | | | |
| Investment | - | 34.86 | 12.98 | 113.95 | 268.31 |
| Annual | - | 4.57 | 1.84 | 15.44 | 53.48 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 3.2 | 0.2 | 0.2 | 0.2 | 0 |
| Oil and Grease | 4,194.9 | 1.9 | 0.6 | 0.6 | - |
| Total Suspended Solids | 355.0 | 4.4 | 2.7 | 2.7 | - |
| Total Toxic Metals | 11.4 | 0.3 | 0.2 | 0.2 | - |
| Total Organics | 8.1 | 0.2 | 0.2 | 0.2 | - |
| SUBCATEGORY COST SUMMARY(2) (\$$\mathrm{X}10^{-6}$) | | | | | |
| Investment | - | 0.15 | 0.09 | 1.99 | 3.89 |
| Annual | - | 0.02 | 0.01 | 0.26 | 0.57 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COLD FORMING SUBCATEGORY
## COLD ROLLING

DIRECT DISCHARGERS[1]

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 29.6 | 28.1 | 28.1 | 28.1 | 0 |
| Oil and Grease | 86,942.3 | 285.8 | 81.7 | 81.7 | - |
| Total Suspended Solids | 22,502.3 | 653.0 | 400.0 | 400.0 | - |
| Total Toxic Metals | 93.7 | 21.4 | 9.8 | 9.8 | - |
| Total Organics | 336.5 | 4.1 | 4.0 | 3.8 | - |
| SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$) | | | | | |
| Investment | - | 27.71 | 12.98 | 113.95 | 268.31 |
| Annual | - | 3.64 | 1.84 | 15.44 | 53.48 |

INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.2 | 0.2 | 0.2 | 0.2 | 0 |
| Oil and Grease | 3,986.2 | 1.9 | 0.6 | 0.6 | - |
| Total Suspended Solids | 274.7 | 4.4 | 2.7 | 2.7 | - |
| Total Toxic Metals | 5.4 | 0.3 | 0.2 | 0.2 | - |
| Total Organics | 2.1 | 0.2 | 0.2 | 0.2 | - |
| SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$) | | | | | |
| Investment | - | 0.06 | 0.09 | 1.99 | 3.89 |
| Annual | - | 0.008 | 0.01 | 0.26 | 0.57 |

---

(1) The raw waste load and BPT cost contributions of the zero discharge operations (contract haul) are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### COLD FORMING SUBCATEGORY
### COLD WORKED PIPE AND TUBE

| | DIRECT DISCHARGERS | |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT BAT |
| Flow (MGD) | 43.7 | 0 |
| Oil and Grease | 2,655,995.5 | - |
| Total Suspended Solids | 27,068.2 | - |
| Total Toxic Metals | 226.9 | - |
| Total Organics | 20.4 | - |
| SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$) | | |
| Investment | - | 7.15 |
| Annual | - | 0.93 |

| | INDIRECT (POTW) DISCHARGERS | |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES |
| Flow (MGD) | 3.0 | 0 |
| Oil and Grease | 208.7 | - |
| Total Suspended Solids | 80.3 | - |
| Total Toxic Metals | 1.0 | - |
| Total Toxic Organics | - | - |
| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | |
| Investment | - | 0.09 |
| Annual | - | 0.01 |

---

(1) The cost summary totals do not include confidential plants.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COLD FORMING SUBCATEGORY
## COLD ROLLING - RECIRCULATION, SINGLE STAND

DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW(2) WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.05 | 0.03 | 0.03 | 0.03 | 0 |
| Oil and Grease | 1,104.6 | 0.3 | 0.1 | 0.1 | - |
| Total Suspended Solids | 76.1 | 0.7 | 0.4 | 0.4 | - |
| Total Toxic Metals | 1.5 | (1) | (1) | (1) | - |
| Total Organics | 0.6 | (1) | (1) | (1) | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 1.10 | 0.10 | 2.32 | 6.80 |
| Annual | - | 0.16 | 0.02 | 0.31 | 0.95 |

INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.007 | 0.007 | 0.007 | 0.007 | 0 |
| Oil and Grease | 144.1 | 0.1 | (1) | (1) | - |
| Total Suspended Solids | 9.9 | 0.2 | 0.1 | 0.1 | - |
| Total Toxic Metals | 0.2 | (1) | (1) | (1) | - |
| Total Organics | 0.1 | (1) | (1) | (1) | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 0.03 | 0.02 | 0.42 | 1.22 |
| Annual | - | 0.005 | 0.003 | 0.06 | 0.17 |

---

(1) Load is less than or equal to 0.05 ton/year.

(2) Raw waste loads for contract haul plants have been included in these totals.

# SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
# COLD FORMING SUBCATEGORY
# COLD ROLLING - RECIRCULATION, MULTI STAND

## DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW[1] WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.4 | 1.3 | 1.3 | 1.3 | 0 |
| Oil and Grease | 30,736.6 | 12.8 | 3.7 | 3.7 | - |
| Total Suspended Solids | 2,118.1 | 29.3 | 17.9 | 17.9 | - |
| Total Toxic Metals | 41.6 | 1.7 | 0.6 | 0.6 | - |
| Total Organics | 15.7 | 0.7 | 0.6 | 0.5 | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 5.83 | 0.97 | 22.32 | 38.04 |
| Annual | - | 0.40 | 0.13 | 2.87 | 5.68 |

## INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.2 | 0.2 | 0.2 | 0.2 | 0 |
| Oil and Grease | 3,842.1 | 1.8 | 0.5 | 0.5 | - |
| Total Suspended Solids | 264.8 | 4.2 | 2.6 | 2.6 | - |
| Total Toxic Metals | 5.2 | 0.2 | 0.1 | 0.1 | - |
| Total Organics | 2.0 | 0.1 | 0.1 | 0.1 | - |
| **SUBCATEGORY COST SUMMARY ($X10$^{-6}$)** | | | | | |
| Investment | - | 0.03 | 0.07 | 1.57 | 2.67 |
| Annual | - | 0.003 | 0.009 | 0.20 | 0.40 |

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(1) Raw waste loads for contract haul plants have been included in these totals.

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### COLD FORMING SUBCATEGORY
### COLD ROLLING - COMBINATION

DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 14.4 | 14.4 | 14.4 | 14.4 | 0 |
| Oil and Grease | 30,966.6 | 146.4 | 41.8 | 41.8 | - |
| Total Suspended Solids | 17,626.5 | 334.5 | 204.9 | 204.9 | - |
| Total Toxic Metals | 32.2 | 10.2 | 4.6 | 4.6 | - |
| Total Organics | 217.5 | 1.6 | 1.6 | 1.6 | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 7.57 | 5.80 | 41.25 | 127.19 |
| Annual | - | 1.29 | 0.81 | 5.72 | 25.55 |

---

Note: There are no indirect dischargers in this segment.

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### COLD FORMING SUBCATEGORY
### COLD ROLLING - DIRECT APPLICATION, SINGLE STAND

| | DIRECT DISCHARGERS | | | | |
|---|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW[1] WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
| Flow (MGD) | 1.8 | 1.6 | 1.6 | 1.6 | 0 |
| Oil and Grease | 3,175.6 | 16.5 | 4.7 | 4.7 | - |
| Total Suspended Solids | 352.8 | 37.6 | 23.1 | 23.1 | - |
| Total Toxic Metals | 2.4 | 1.2 | 0.6 | 0.6 | - |
| Total Organics | 13.5 | 0.2 | 0.2 | 0.2 | - |
| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | | | | |
| Investment | - | 4.02 | 0.92 | 15.65 | 20.36 |
| Annual | - | 0.58 | 0.16 | 2.04 | 3.57 |

---

Note: There are no indirect dischargers in this segment.

(1) Raw waste loads for contract haul plants have been included in these totals.

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### COLD FORMING SUBCATEGORY
### COLD ROLLING - DIRECT APPLICATION, MULTI STAND

|  | DIRECT DISCHARGERS |  |  |  |  |
|---|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW[(1)] WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
| Flow (MGD) | 11.9 | 10.8 | 10.8 | 10.8 | 0 |
| Oil and Grease | 20,958.9 | 109.8 | 31.4 | 31.4 | - |
| Total Suspended Solids | 2,328.8 | 250.9 | 153.7 | 153.7 | - |
| Total Toxic Metals | 16.0 | 8.3 | 3.9 | 3.9 | - |
| Total Organics | 89.2 | 1.5 | 1.5 | 1.5 | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) |  |  |  |  |  |
| Investment | - | 9.19 | 5.19 | 32.41 | 75.92 |
| Annual | - | 1.21 | 0.72 | 4.50 | 17.73 |

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Note: There are no indirect dischargers in this segment.

(1) Raw waste loads for contract haul plants have been included in these totals.

### SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
### COLD FORMING SUBCATEGORY
### COLD WORKED PIPE AND TUBE - USING WATER

| | DIRECT DISCHARGERS | |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT BAT |
| Flow (MGD) | 19.2 | 0 |
| Oil and Grease | 1,356.7 | - |
| Total Suspended Solids | 521.8 | - |
| Total Toxic Metals | 6.8 | - |
| Total Toxic Organics | - | - |
| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | |
| Investment | - | 4.06 |
| Annual | - | 0.53 |

| | INDIRECT (POTW) DISCHARGERS | |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES |
| Flow (MGD) | 3.0 | 0 |
| Oil and Grease | 208.7 | - |
| Total Suspended Solids | 80.3 | - |
| Total Toxic Metals | 1.0 | - |
| Total Toxic Organics | - | - |
| SUBCATEGORY COST SUMMARY ($X10$^{-6}$) | | |
| Investment | - | 0.09 |
| Annual | - | 0.01 |

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## COLD FORMING SUBCATEGORY
## COLD WORKED PIPE AND TUBE - USING OIL

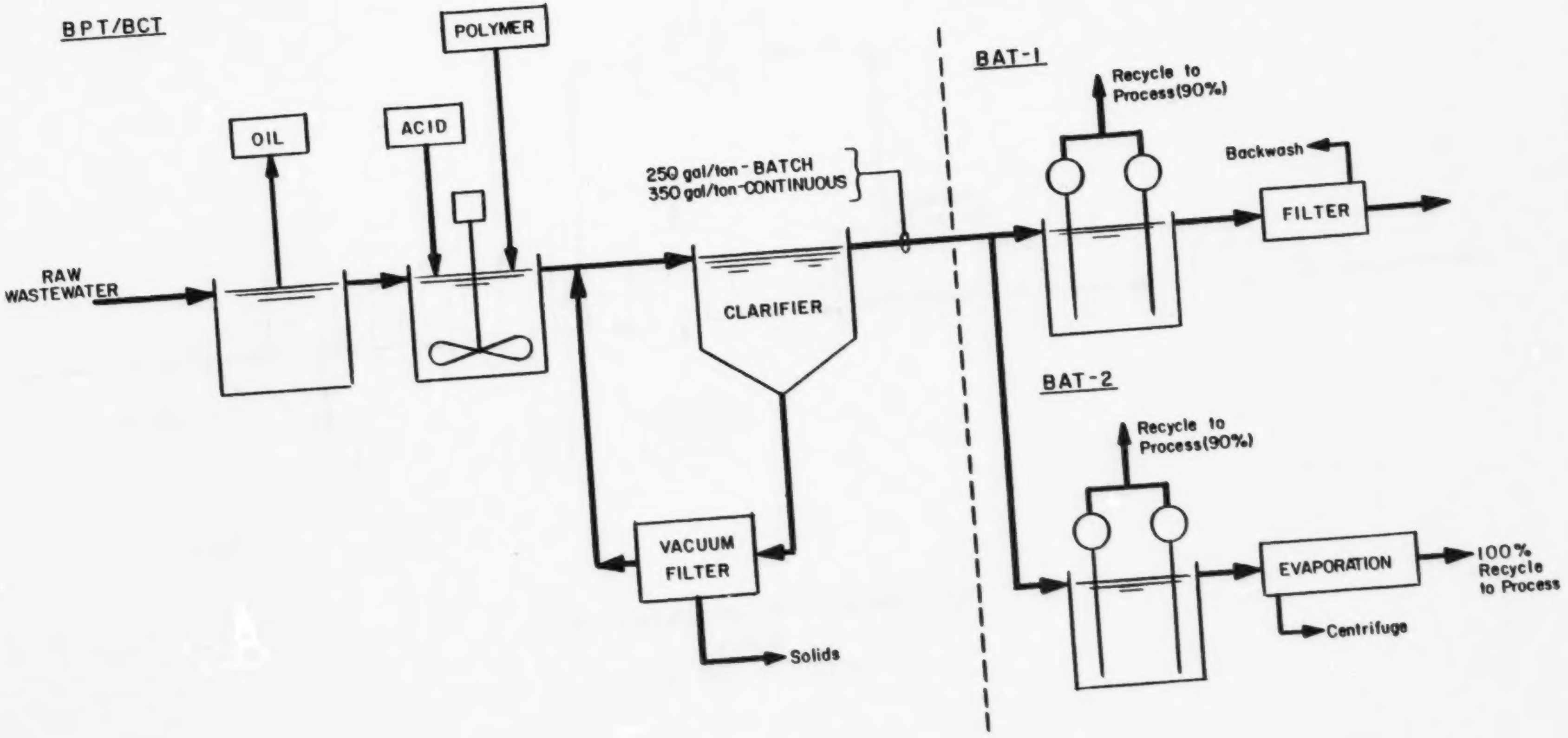
|  | DIRECT DISCHARGERS |  |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT BAT |
| Flow (MGD) | 24.5 | 0 |
| Oil and Grease | 2,654,638.8 | - |
| Total Suspended Solids | 26,546.4 | - |
| Total Toxic Metals | 220.1 | - |
| Total Organics | 20.4 | - |
| SUBCATEGORY COST SUMMARY(1) ($X10$^{-6}$) |  |  |
| Investment | - | 3.09 |
| Annual | - | 0.40 |

---

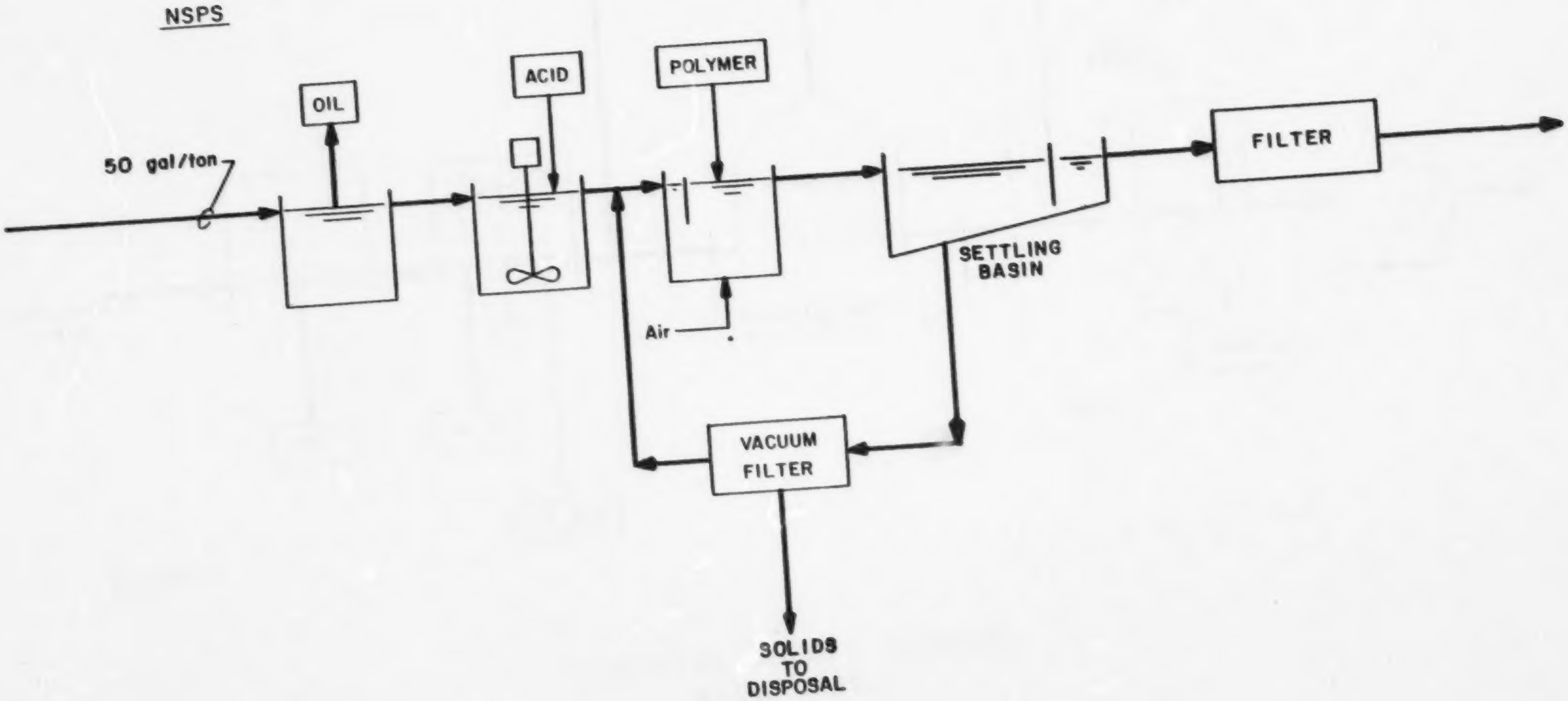
Note: There are no indirect dischargers in this subdivision.

(1) The cost summary totals do not include confidential plants.

## ALKALINE CLEANING
## BPT/BCT/BAT
## TREATMENT MODELS SUMMARY



## ALKALINE CLEANING
## NSPS
## TREATMENT MODELS SUMMARY



## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Alkaline Cleaning
: Batch

MODEL SIZE (TPD): 150
OPER. DAYS/YEAR : 250
TURNS/DAY : 2

**RAW WASTE FLOWS**

| | | |
|---|---|---|
| | Model Plant | 0.04 MGD |
| 22 | Direct Dischargers | 0.8 MGD |
| 9 | Indirect Dischargers | 0.3 MGD |
| 31 | Active Plants | 1.1 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/ BCT | BAT-1 | BAT-2 |
|---|---|---|---|
| Investment | 381 | 37.6 | 840 |
| Annual | 49.8 | 5.0 | 108 |
| \$/Ton of Production | 1.33 | 0.13 | 2.88 |

| | NSPS |
|---|---|
| Investment | 237 |
| Annual | 30.7 |
| \$/Ton of Production | 0.82 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/ BCT | BAT-1 NSPS | BAT-2 |
|---|---|---|---|---|---|
| | Flow (GPT) NSPS only | 50 | | 50 | |
| | Flow (GPT) | 250 | 250 | 25 | 0 |
| | pH (SU) | 7-11 | 6-9 | 6-9 | - |
| | Dissolved Iron | 0.38 | 0.38 | 0.38 | - |
| | Oil and Grease$^{(1)}$ | 13 | (10)4.4 | (5**)2 | - |
| | Total Suspended Solids$^{(1)}$ | 10 | (30)23.8 | (15)9.8 | - |
| 36 | 2,6-Dinitrotoluene | 0.016 | 0.016 | 0.016 | - |
| 39 | Fluoranthene | 0.017 | 0.017 | 0.01 | - |
| 84 | Pyrene | 0.11 | 0.011 | 0.005 | - |
| 114 | Antimony | 0.048 | 0.048 | 0.048 | - |
| 119 | Chromium | 0.085 | 0.04 | 0.03 | - |
| 121 | Cyanide | 0.019 | 0.019 | 0.019 | - |
| 122 | Lead | 0.038 | 0.038 | 0.038 | - |
| 124 | Nickel | 0.013 | 0.013 | 0.013 | - |
| 125 | Selenium | 0.07 | 0.07 | 0.07 | - |
| 128 | Zinc* | 0.12 | 0.06 | 0.06 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT costs are incremental over BPT costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) The BPT and BCT total suspended solids and oil and grease limitations for alkaline cleaning operations are applicable when alkaline cleaning wastewaters are co-treated with wastewaters from other steel finishing operations.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Alkaline Cleaning
: Continuous

MODEL SIZE (TPD): 1500
OPER. DAYS/YEAR : 250
TURNS/DAY : 2

| RAW WASTE FLOWS | |
|---|---|
| Model Plant | 0.5 MGD |
| 22 Direct Dischargers | 11.6 MGD |
| 9 Indirect Dischargers | 4.7 MGD |
| 31 Active Plants | 16.3 MGD |

| MODEL COSTS ($\$X10^{-3}$) | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|
| Investment | 832 | 367 | 2430 |
| Annual | 115 | 46.1 | 348 |
| $/Ton of Production | 0.31 | 0.12 | 0.93 |

| | NSPS |
|---|---|
| Investment | 553 |
| Annual | 73.8 |
| $/Ton of Production | 0.20 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | BPT/BCT | BAT-1 NSPS | BAT-2 |
|---|---|---|---|---|
| Flow (GPT) NSPS only | 50 | | 50 | |
| Flow (GPT) | 350 | 350 | 35 | 0 |
| pH (SU) | 7-11 | 6-9 | 6-9 | - |
| Dissolved Iron | 0.38 | 0.38 | 0.38 | - |
| Oil and Grease(1) | 13 | (10)4.4 | (5**)2 | - |
| Total Suspended Solids(1) | 10 | (30)23.8 | (15)9.8 | - |
| 36 2,6-Dinitrotoluene | 0.016 | 0.016 | 0.016 | - |
| 39 Fluoranthene | 0.017 | 0.017 | 0.01 | - |
| 84 Pyrene | 0.011 | 0.011 | 0.005 | - |
| 114 Antimony | 0.048 | 0.048 | 0.048 | - |
| 119 Chromium | 0.085 | 0.04 | 0.03 | - |
| 121 Cyanide | 0.019 | 0.019 | 0.019 | - |
| 122 Lead | 0.038 | 0.038 | 0.038 | - |
| 124 Nickel | 0.013 | 0.013 | 0.013 | - |
| 125 Selenium | 0.07 | 0.07 | 0.07 | - |
| 128 Zinc* | 0.12 | 0.06 | 0.06 | - |

---

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT costs are incremental over BPT costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

*Toxic pollutant found in all raw waste samples.
**Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) The BPT and BCT total suspended solids and oil and grease limitations for alkaline cleaning operations are applicable when alkaline cleaning wastewaters are co-treated with wastewaters from other steel finishing operations.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## ALKALINE CLEANING SUBCATEGORY

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
|---|---|---|---|---|
| Flow (MGD) | 12.4 | 12.4 | 1.3 | 0 |
| Dissolved Iron | 4.9 | 4.9 | 0.5 | - |
| Oil and Grease | 167.8 | 56.8 | 2.6 | - |
| Total Suspended Solids | 129.1 | 307.2 | 12.6 | - |
| Total Toxic Metals | 4.8 | 3.4 | 0.3 | - |
| Total Organics(1) | 0.9 | 0.9 | 0.1 | - |
| **SUBCATEGORY COST SUMMARY(2) ($\$X10^{-6}$)** | | | | |
| Investment | - | 12.26 | 7.61 | 57.72 |
| Annual | - | 1.68 | 0.96 | 8.10 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES |
|---|---|---|
| Flow (MGD) | 5.5 | (3) |
| Dissolved Iron | 1.9 | |
| Oil and Grease | 68.7 | |
| Total Suspended Solids | 52.8 | |
| Total Toxic Metals | 1.9 | |
| Total Organics(1) | 0.3 | |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | |
| Investment | - | |
| Annual | - | |

---

(1) Total Organics load includes total cyanide.

(2) The cost summary totals do not include confidential plants.

(3) General Pretreatment Regulations apply, 40 CFR Part 403.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## ALKALINE CLEANING SUBCATEGORY
## BATCH

|  | DIRECT DISCHARGERS |  |  |  |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
| Flow (MGD) | 0.8 | 0.8 | 0.08 | 0 |
| Dissolved Iron | 0.3 | 0.3 | (1) | - |
| Oil and Grease | 11.2 | 3.8 | 0.2 | - |
| Total Suspended Solids | 8.6 | 20.5 | 0.8 | - |
| Total Toxic Metals | 0.3 | 0.2 | (1) | - |
| Total Organics(3) | 0.1 | 0.1 | (1) | - |
| SUBCATEGORY COST SUMMARY(2) ($\$X10^{-6}$) |  |  |  |  |
| Investment | - | 1.98 | 0.46 | 10.35 |
| Annual | - | 0.26 | 0.06 | 1.32 |

|  | INDIRECT (POTW) DISCHARGERS |  |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES |
| Flow (MGD) | 0.4 | (4) |
| Dissolved Iron | 0.1 |  |
| Oil and Grease | 4.6 |  |
| Total Suspended Solids | 3.5 |  |
| Total Toxic Metals | 0.1 |  |
| Total Organics(3) | (1) |  |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) |  |  |
| Investment | - |  |
| Annual | - |  |

---

(1) Load is less than or equal to 0.05 ton/year.
(2) The cost summary totals do not include confidential plants.
(3) Total Organics load includes total cyanide.
(4) General Pretreatment Regulations apply, 40 CFR part 403.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## ALKALINE CLEANING SUBCATEGORY
## CONTINUOUS

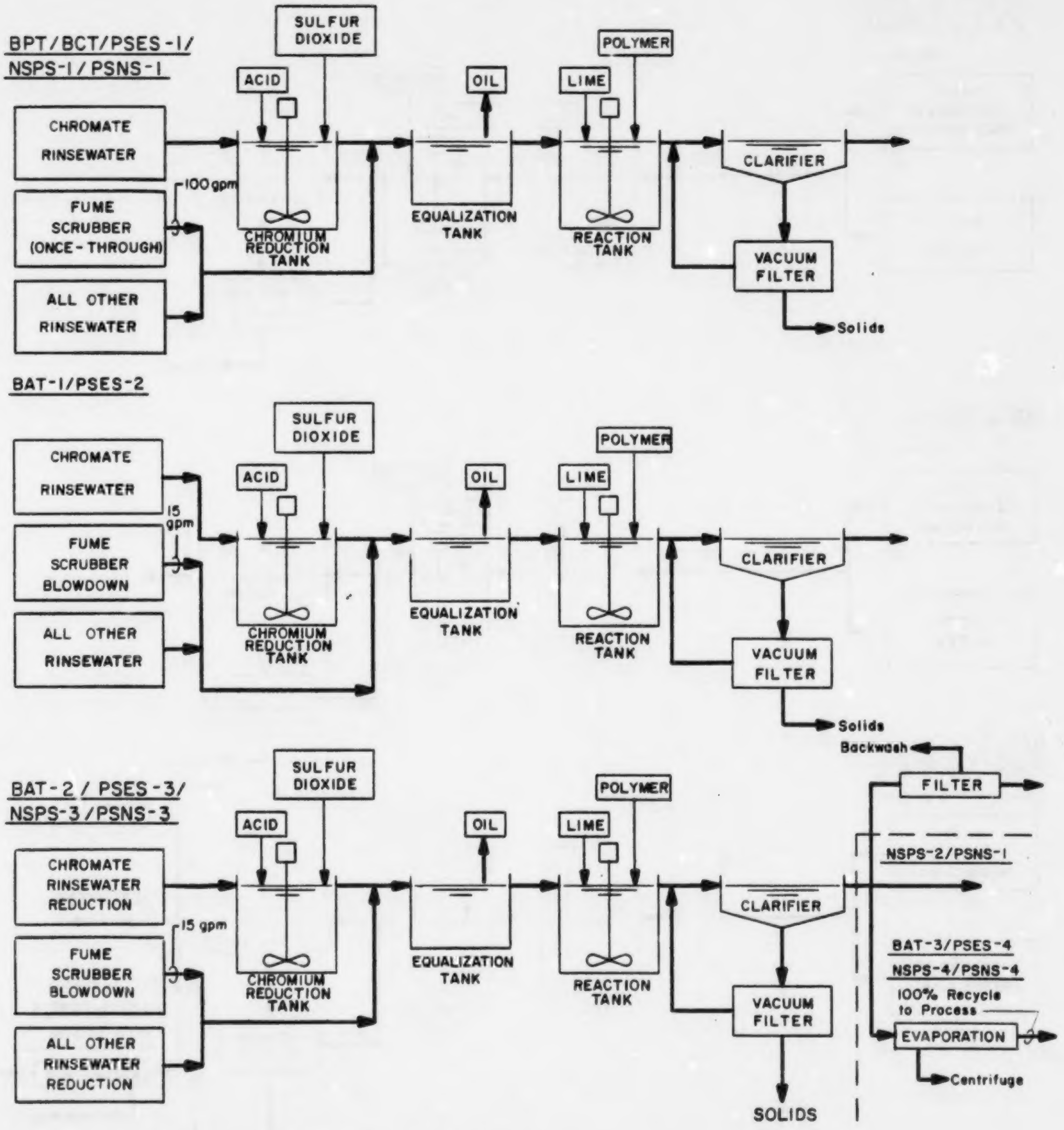
| | DIRECT DISCHARGERS | | | |
|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 |
| Flow (MGD) | 11.6 | 11.6 | 1.2 | 0 |
| Dissolved Iron | 4.6 | 4.6 | 0.5 | - |
| Oil and Grease | 156.6 | 53.0 | 2.4 | - |
| Total Suspended Solids | 120.5 | 286.7 | 11.8 | - |
| Total Toxic Metals | 4.5 | 3.2 | 0.3 | - |
| Total Organics(1) | 0.8 | 0.8 | 0.1 | - |
| SUBCATEGORY COST SUMMARY(2) (\$X10$^{-6}$) | | | | |
| Investment | - | 10.28 | 7.15 | 47.37 |
| Annual | - | 1.42 | 0.90 | 6.78 |

| | INDIRECT (POTW) DISCHARGERS | |
|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES |
| Flow (MGD) | 4.7 | (3) |
| Dissolved Iron | 1.8 | |
| Oil and Grease | 64.1 | |
| Total Suspended Solids | 49.3 | |
| Total Toxic Metals | 1.8 | |
| Total Organics(1) | 0.3 | |
| SUBCATEGORY COST SUMMARY (\$X10$^{-6}$) | | |
| Investment | - | |
| Annual | - | |

---

(1) Total organics load includes total cyanide.
(2) The cost summary totals do not include confidential plants.
(3) General Pretreatment Regulations apply, 40 CFR part 403.

# HOT COATING / GALVANIZING TREATMENT MODELS SUMMARY



HOT COATING RINSE WATER FLOW RATES (GPT)

| PRODUCT | BPT/BCT/PSES-1 & 2<br>BAT-1/NSPS-1/PSNS-1 (1) | ALL OTHER MODELS (2) |
|---|---|---|
| Strip / Sheet & Misc. Products | 600 | 150 |
| Wire Products & Fasteners | 2400 | 600 |

(1) Fume scrubber flow at BPT/BCT/PSES-1/NSPS-1/PSNS-1: 100 gpm/scrubber

(2) Fume scrubber flow at all other models: 15 gpm/scrubber

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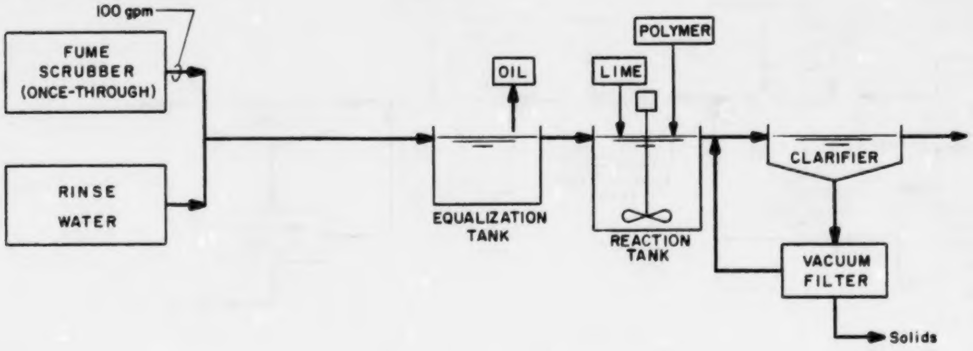
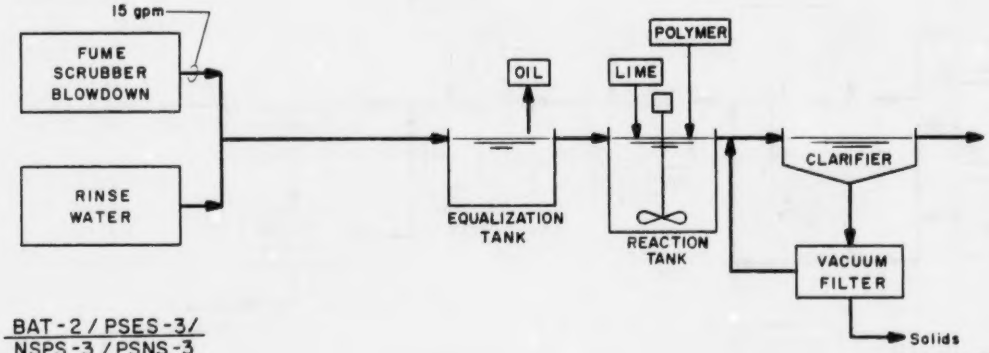
# HOT COATING/TERNE & OTHER METALS TREATMENT MODELS SUMMARY

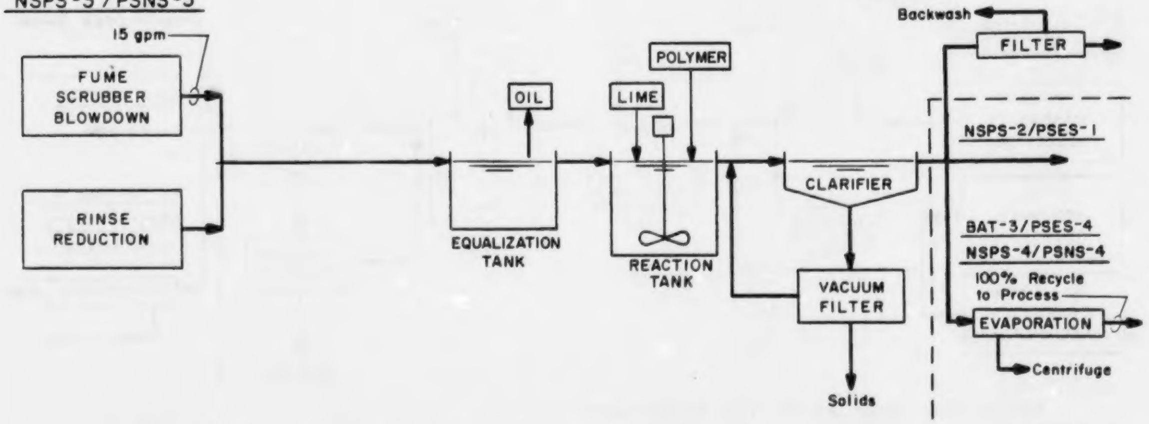
BPT/BCT/PSES-1/NSPS-1/PSNS-1



BAT-1/PSES-2



BAT-2/PSES-3/NSPS-3/PSNS-3



HOT COATING RINSE WATER FLOW RATES (GPT)

| PRODUCT | BAT/BCT/PSES-1&2/ BAT-1/NSPS-1/PSNS-1(1) | ALL OTHER MODELS(2) |
|---|---|---|
| Strip/Sheet & Misc. Products | 600 | 150 |
| Wire Products & Fasteners | 2400 | 600 |

(1) Fume scrubber flow at BPT/BCT/PSES-1/NSPS-1/PSNS-1: 15 gpm/scrubber

(2) Fume scrubber at all other models: 15 gpm/scrubber

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Galvanizing
: Strip, Sheet and Miscellaneous Products

MODEL SIZE (TPD): 800
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

**RAW WASTE FLOWS**

| Rinses | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.5 MGD | Model Plant | 0.3 MGD | |
| 25 Direct Dischargers | 12.0 MGD | 11 Direct Dischargers | 3.2 MGD | 15.2 MGD |
| 3 Indirect Dischargers | 1.4 MGD | 1 Indirect Dischargers | 0.3 MGD | 1.7 MGD |
| 5 Zero Dischargers | 0.1 MGD | 1 Zero Dischargers | <0.03 MGD | 0.1 MGD |
| 33 Active Plants | 13.5 MGD | 13 Active Plants | 3.5 MGD | 17.0 MGD |

| MODEL COST ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 739 | - | 408 | 2593 |
| Plants With Scrubbers | 943 | 59.1 | 491 | 2864 |
| Annual | | | | |
| Plants Without Scrubbers | 120 | - | 51.8 | 402 |
| Plants With Scrubbers | 154 | 8.3 | 63.3 | 452 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 0.58 | - | 0.25 | 1.93 |
| Plants With Scrubbers | 0.74 | 0.04 | 0.30 | 2.17 |

| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 | NSPS-4<br>PSNS-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 739 | 822 | 942 | 3127 |
| Plants With Scrubbers | 943 | 951 | 1095 | 3467 |
| Annual | | | | |
| Plants Without Scrubbers | 120 | 128 | 143 | 493 |
| Plants With Scrubbers | 154 | 152 | 170 | 559 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 0.58 | 0.61 | 0.69 | 2.37 |
| Plants With Scrubbers | 0.74 | 0.73 | 0.82 | 2.69 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | NSPS-1<br>PSNS-1<br>PSES-1<br>BPT/BCT | PSES-2<br>BAT-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3<br>PSES-3<br>BAT-2 | NSPS-4<br>PSNS-4<br>PSES-4<br>BAT-3 |
|---|---|---|---|---|---|---|---|
| | No Scrub | W/Scrub | | | | | |
| Flow (GPT) | 600 | (1) | 600$^{(1)}$ | 600$^{(2)}$ | 150$^{(2)}$ | 150$^{(2)}$ | 0 |
| pH (SU) | 2-9 | 2-8 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Dissolved Iron | 16 | 10 | 1 | 1 | 1 | 0.5 | - |
| Hexavalent Chromium$^{(3)}$ | 1 | 0.6 | (0.02)0.01 | (0.02)0.01 | (0.02)0.01 | (0.02)0.01 | - |
| Oil and Grease | 60 | 45 | (10)4.4 | (10)4.4 | (10)4.4 | (5**)2 | - |
| Total Suspended Solids | 120 | 100 | (30)23.8 | (30)23.8 | (30)23.8 | (15)9.8 | - |
| 115 Arsenic* | 0.2 | 0.12 | 0.1 | 0.1 | 0.1 | 0.1 | - |
| 119 Chromium | 7 | 4 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 120 Copper* | 0.8 | 0.5 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 122 Lead | 0.6 | 0.4 | (0.15)0.1 | (0.15)0.1 | (0.15)0.1 | (0.1)0.06 | - |
| 124 Nickel | 1 | 0.8 | 0.15 | 0.15 | 0.15 | 0.04 | - |
| 128 Zinc* | 120 | 80 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each galvanizing line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each galvanizing line.
(3) Limitations/standards apply only to plants discharging wastewaters from a chromate rinsing step.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Galvanizing
: Wire Products and Fasteners

MODEL SIZE (TPD): 100
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

| Rinses | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.24 MGD | Model Plant | 0.3 MGD | |
| 15 Direct Dischargers | 3.6 MGD | 6 Direct Dischargers | 1.7 MGD | 5.3 MGD |
| 14 Indirect Dischargers | 3.4 MGD | 7 Indirect Dischargers | 2.0 MGD | 5.4 MGD |
| 1 Zero Discharger | 0 MGD | 0 Zero Dischargers | 0 MGD | 0 MGD |
| 30 Active Plants | 7.0 MGD | 13 Active Plants | 3.7 MGD | 10.7 MGD |

| MODEL COST ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 557 | - | 85.5 | 1982 |
| Plants With Scrubbers | 724 | 59.1 | 205 | 2363 |
| Annual | | | | |
| Plants Without Scrubbers | 83.9 | - | 11.1 | 283 |
| Plants With Scrubbers | 113 | 8.3 | 27.3 | 357 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 3.23 | - | 0.43 | 10.88 |
| Plants With Scrubbers | 4.35 | 0.32 | 1.05 | 13.73 |

| | NSPS-1 PSNS-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 | NSPS-4 PSNS-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 557 | 421 | 471 | 2367 |
| Plants With Scrubbers | 724 | 583 | 694 | 2852 |
| Annual | | | | |
| Plants Without Scrubbers | 83.9 | 65.0 | 71.5 | 344 |
| Plants With Scrubbers | 113 | 92.6 | 107 | 437 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 3.23 | 2.50 | 2.75 | 13.23 |
| Plants With Scrubbers | 4.35 | 3.56 | 4.12 | 16.81 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | NSPS-1 PSNS-1 PSES-1 BPT/BCT | PSES-2 BAT-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 PSES-3 BAT-2 | NSPS-4 PSNS-4 PSES-4 BAT-3 |
|---|---|---|---|---|---|---|---|
| | No Scrub | W/Scrub | | | | | |
| Flow (GPT) | 2400 | (1) | 2400(1) | 2400(2) | 600(2) | 600(2) | 0 |
| pH (SU) | 3-9 | 3-9 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Dissolved Iron | 10 | 5 | 1 | 1 | 1 | 0.5 | - |
| Hexavalent Chromium(3) | 0.2 | 0.1 | (0.02)0.01 | (0.02)0.01 | (0.02)0.01 | (0.02)0.01 | - |
| Oil and Grease | 25 | 15 | (10)4.4 | (10)4.4 | (10)4.4 | (5**)2 | - |
| Total Suspended Solids | 80 | 50 | (30)23.8 | (30)23.8 | (30)23.8 | (15)9.8 | - |
| 115 Arsenic | 0.25 | 0.15 | 0.1 | 0.1 | 0.1 | 0.1 | - |
| 119 Chromium* | 2 | 1 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 120 Copper* | 0.8 | 0.4 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 122 Lead* | 2 | 1 | (0.15)0.1 | (0.15)0.1 | (0.15)0.1 | (0.1)0.06 | - |
| 124 Nickel* | 0.5 | 0.2 | 0.15 | 0.15 | 0.15 | 0.04 | - |
| 128 Zinc* | 10 | 5 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each galvanizing line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each galvanizing line.
(3) Limitations/standards apply only to plants discharging wastewaters from a chromate rinsing step.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Hot Coating - Terne | MODEL SIZE (TPD): | 365 |
| : | All Products | OPER. DAYS/YEAR : | 260 |
| | | TURNS/DAY : | 3 |

RAW WASTE FLOWS

| Rinses | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.22 MGD | Model Plant | 0.14 MGD | |
| 4 Direct Dischargers | 0.9 MGD | 3 Direct Dischargers | 0.4 MGD | 1.3 MGD |
| 1 Indirect Discharger | 0.2 MGD | 0 Indirect Dischargers | 0 MGD | 0.2 MGD |
| 5 Active Plants | 1.1 MGD | 3 Active Plants | 0.4 MGD | 1.5 MGD |

| MODEL COST ($X10$^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 477 | - | 178 | 2030 |
| Plants With Scrubbers | 557 | 53.8 | 242 | 2260 |
| Annual | | | | |
| Plants Without Scrubbers | 70.1 | - | 22.6 | 286 |
| Plants With Scrubbers | 84.3 | 7.4 | 31.4 | 328 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 0.74 | - | 0.24 | 3.01 |
| Plants With Scrubbers | 0.89 | 0.088 | 0.33 | 3.46 |

| | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 | NSPS-4<br>PSNS-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 477 | 452 | 499 | 2351 |
| Plants With Scrubbers | 557 | 545 | 602 | 2620 |
| Annual | | | | |
| Plants Without Scrubbers | 70.1 | 65.1 | 71.2 | 335 |
| Plants With Scrubbers | 84.3 | 80.5 | 88.0 | 384 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 0.74 | 0.69 | 0.75 | 3.53 |
| Plants With Scrubbers | 0.89 | 0.85 | 0.93 | 4.05 |

| WASTEWATER CHARACTERISTICS | RAW WASTE No Scrub | RAW WASTE W/Scrub | NSPS-1<br>PSNS-1<br>PSES-1<br>BPT/BCT | PSES-2<br>BAT-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3<br>PSES-3<br>BAT-2 | NSPS-4<br>PSNS-4<br>PSES-4<br>BAT-3 |
|---|---|---|---|---|---|---|---|
| Flow (GPT) | 600 | (1) | $600^{(1)}$ | $600^{(2)}$ | $150^{(2)}$ | $150^{(2)}$ | 0 |
| pH (SU) | 2-8 | 2-8 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Dissolved Iron | 40 | 25 | 1 | 1 | 1 | 0.5 | - |
| Oil and Grease | 30 | 20 | (10)4.4 | (10)4.4 | (10)4.4 | (5**)2 | - |
| Tin | 3 | 2 | 0.5 | 0.5 | 0.5 | 0.1 | - |
| Total Suspended Solids | 75 | 50 | (30)23.8 | (30)23.8 | (30)23.8 | (15)9.8 | - |
| 115 Arsenic | 0.15 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | - |
| 118 Cadmium* | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.05 | - |
| 119 Chromium* | 5 | 3 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 120 Copper | 0.6 | 0.4 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 122 Lead* | 1.2 | 0.8 | (0.15)0.1 | (0.15)0.1 | (0.15)0.1 | (0.1)0.06 | - |
| 124 Nickel* | 1 | 0.6 | 0.15 | 0.15 | 0.15 | 0.04 | - |
| 128 Zinc* | 1.5 | 1 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based on 100 gpm per scrubber serving each coating line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each coating line.

## SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

| | | | |
|---|---|---|---|
| SUBCATEGORY: | Hot Coating - Other Metallic Coatings | MODEL SIZE (TPD): | 500 |
| : | Strip, Sheet and Miscellaneous Products | OPER. DAYS/YEAR : | 260 |
| | | TURNS/DAY : | 2 |

**RAW WASTE FLOWS**

| Rinses | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.3 MGD | Model Plant | 0.1 MGD | |
| 3 Direct Dischargers | 0.9 MGD | 0 Direct Dischargers | 0 MGD | 0.9 MGD |
| 0 Indirect Dischargers | 0 MGD | 0 Indirect Dischargers | 0 MGD | 0 MGD |
| 1 Zero Discharger | <0.01 MGD | 0 Zero Dischargers | 0 MGD | <0.01 MGD |
| 4 Active Plants | 0.9 MGD | 0 Active Plants | 0 MGD | 0.9 MGD |

| MODEL COST ($\$X10^{-3}$) | BPT/BCT<br>PSES-1 | BAT-1<br>PSES-2 | BAT-2<br>PSES-3 | BAT-3<br>PSES-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 571 | - | 236 | 2232 |
| Plants With Scrubbers | 660 | 53.8 | 339 | 2605 |
| Annual | | | | |
| Plants Without Scrubbers | 89.5 | - | 30.1 | 323 |
| Plants With Scrubbers | 106 | 7.4 | 43.6 | 383 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 0.69 | - | 0.23 | 2.48 |
| Plants With Scrubbers | 0.82 | 0.06 | 0.34 | 2.95 |

| MODEL COST ($\$X10^{-3}$) | NSPS-1<br>PSNS-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3 | NSPS-4<br>PSNS-4 |
|---|---|---|---|---|
| Investment | | | | |
| Plants Without Scrubbers | 571 | 568 | 624 | 2620 |
| Plants With Scrubbers | 660 | 684 | 790 | 3055 |
| Annual | | | | |
| Plants Without Scrubbers | 89.5 | 86.8 | 94.3 | 387 |
| Plants With Scrubbers | 106 | 107 | 120 | 460 |
| $/Ton of Production | | | | |
| Plants Without Scrubbers | 0.69 | 0.67 | 0.73 | 2.98 |
| Plants With Scrubbers | 0.82 | 0.82 | 0.92 | 3.54 |

| WASTEWATER CHARACTERISTICS | RAW WASTE | | NSPS-1<br>PSNS-1<br>PSES-1<br>BPT/BCT | PSES-2<br>BAT-1 | NSPS-2<br>PSNS-2 | NSPS-3<br>PSNS-3<br>PSES-3<br>BAT-2 | NSPS-4<br>PSNS-4<br>PSES-4<br>BAT-3 |
|---|---|---|---|---|---|---|---|
| | No Scrub | W/Scrub | | | | | |
| Flow (GPT) | 600 | (1) | $600^{(1)}$ | $600^{(2)}$ | $150^{(2)}$ | $150^{(2)}$ | 0 |
| pH (SU) | 2-9 | 3-9 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| Aluminum | 30 | 20 | 1 | 1 | 1 | 0.1 | - |
| Dissolved Iron | 30 | 20 | 1 | 1 | 1 | 0.1 | - |
| Oil and Grease | 60 | 40 | (10)4.4 | (10)4.4 | (10)4.4 | (5**)2 | - |
| Tin | 8 | 5 | 0.5 | 0.5 | 0.5 | 0.1 | - |
| Total Suspended Solids | 400 | 250 | (30)23.8 | (30)23.8 | (30)23.8 | (15)9.8 | - |
| 115 Arsenic* | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | - |
| 118 Cadmium | 0.4 | 0.3 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 119 Chromium* | 0.4 | 0.3 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 120 Copper* | 0.4 | 0.3 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 122 Lead* | 2 | 1.5 | (0.15)0.1 | (0.15)0.1 | (0.15)0.1 | (0.1)0.06 | - |
| 124 Nickel* | 1 | 0.6 | 0.15 | 0.15 | 0.15 | 0.04 | - |
| 128 Zinc* | 5 | 3 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples analyzed.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each coating line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each coating line.

# SUBCATEGORY SUMMARY DATA
## BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Other Metallic Coatings
: Wire Products and Fasteners

MODEL SIZE (TPD): 15
OPER. DAYS/YEAR : 260
TURNS/DAY : 2

**RAW WASTE FLOWS**

| Rinses | | Fume Scrubbers (Additional Flow) | | Total Flow |
|---|---|---|---|---|
| Model Plant | 0.04 MGD | Model Plant | 0.14 MGD | |
| 2 Direct Dischargers | 0.07 MGD | 0 Direct Dischargers | 0 MGD | 0.07 MGD |
| 4 Indirect Dischargers | 0.14 MGD | 0 Indirect Dischargers | 0 MGD | 0.14 MGD |
| 6 Active Plants | 0.21 MGD | 0 Active Plants | 0 MGD | 0.21 MGD |

| MODEL COST ($X10$^{-3}$) | BPT/BCT PSES-1 | BAT-1 PSES-2 | | BAT-2 PSES-3 | BAT-3 PSES-4 |
|---|---|---|---|---|---|
| Investment | | | | | |
| Plants Without Scrubbers | 225 | - | | 20.8 | 1045 |
| Plants With Scrubbers | 404 | 53.8 | | 91.8 | 1538 |
| Annual | | | | | |
| Plants Without Scrubbers | 31.4 | - | | 2.9 | 137 |
| Plants With Scrubbers | 57.9 | 7.4 | | 12.4 | 205 |
| $/Ton of Production | | | | | |
| Plants Without Scrubbers | 8.05 | - | | 0.74 | 35.13 |
| Plants With Scrubbers | 14.85 | 1.90 | | 3.18 | 52.56 |

| | NSPS-1 PSNS-1 | | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 | NSPS-4 PSNS-4 |
|---|---|---|---|---|---|
| Investment | | | | | |
| Plants Without Scrubbers | 225 | | 161 | 176 | 1200 |
| Plants With Scrubbers | 404 | | 335 | 368 | 1814 |
| Annual | | | | | |
| Plants Without Scrubbers | 31.4 | | 22.8 | 24.9 | 159 |
| Plants With Scrubbers | 57.9 | | 48.6 | 52.8 | 245 |
| $/Ton of Production | | | | | |
| Plants Without Scrubbers | 8.05 | | 5.85 | 6.38 | 40.77 |
| Plants With Scrubbers | 14.85 | | 12.46 | 13.54 | 62.82 |

| | WASTEWATER CHARACTERISTICS | RAW WASTE No Scrub | RAW WASTE W/Scrub | NSPS-1 PSNS-1 PSES-1 BPT/BCT | PSES-2 BAT-1 | NSPS-2 PSNS-2 | NSPS-3 PSNS-3 PSES-3 BAT-2 | NSPS-4 PSNS-4 PSES-4 BAT-3 |
|---|---|---|---|---|---|---|---|---|
| | Flow (GPT) | 2400 | (1) | $2400^{(1)}$ | $2400^{(2)}$ | $600^{(2)}$ | $600^{(2)}$ | 0 |
| | pH (SU) | 3-9 | 3-9 | 6-9 | 6-9 | 6-9 | 6-9 | - |
| | Aluminum | 20 | 5 | 1 | 1 | 1 | 0.1 | - |
| | Dissolved Iron | 30 | 8 | 1 | 1 | 1 | 0.5 | - |
| | Oil and Grease | 30 | 15 | (10)4.4 | (10)4.4 | (10)4.4 | (5**)2 | - |
| | Tin | 2 | 1 | 0.5 | 0.5 | 0.5 | 0.1 | - |
| | Total Suspended Solids | 250 | 75 | (30)23.8 | (30)23.8 | (30)23.8 | (15)9.8 | - |
| 115 | Arsenic | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | - |
| 118 | Cadmium | 0.2 | 0.1 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 119 | Chromium* | 0.2 | 0.1 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 120 | Copper* | 0.3 | 0.1 | 0.04 | 0.04 | 0.04 | 0.03 | - |
| 122 | Lead* | 0.6 | 0.2 | (0.15)0.1 | (0.15)0.1 | (0.15)0.1 | (0.1)0.06 | - |
| 124 | Nickel* | 0.4 | 0.2 | 0.15 | 0.15 | 0.15 | 0.04 | - |
| 128 | Zinc* | 1 | 0.5 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | (0.1)0.06 | - |

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Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each coating line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each coating line.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT COATING-ALL SUBDIVISIONS
## ALL PRODUCTS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 22.9 | 22.8 | 18.3 | 5.23 | 0 |
| Aluminum | 31.2 | 1.1 | 1.1 | (2) | - |
| Dissolved Iron | 321.8 | 24.8 | 19.8 | 2.7 | - |
| Hexavalent Chromium | 13.7 | 0.2 | 0.2 | 0.1 | - |
| Oil and Grease | 1,059.9 | 108.7 | 87.0 | 11.2 | - |
| Tin | 11.1 | 1.2 | 1.0 | 0.1 | - |
| Total Suspended Solids | 2,657.8 | 588.1 | 471.1 | 54.8 | - |
| Total Toxic Metals | 1,829.3 | 12.2 | 9.8 | 1.8 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 33.68 | 0.87 | 12.8 | 119.8 |
| Annual | - | 5.07 | 0.12 | 1.64 | 18.7 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 7.5 | 7.5 | 5.6 | 1.6 | 0 |
| Aluminum | 3.1 | 0.2 | 0.2 | (2) | - |
| Dissolved Iron | 77.5 | 8.1 | 6.0 | 0.9 | - |
| Hexavalent Chromium | 2.3 | 0.1 | 0.1 | (2) | - |
| Oil and Grease | 217.1 | 35.7 | 26.3 | 3.6 | - |
| Tin | 1.0 | 0.2 | 0.2 | (2) | - |
| Total Suspended Solids | 611.5 | 192.8 | 142.3 | 17.4 | - |
| Total Toxic Metals | 268.8 | 4.0 | 3.0 | 0.6 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 4.97 | 0.08 | 1.58 | 23.0 |
| Annual | - | 0.73 | 0.01 | 0.21 | 3.35 |

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(1) The cost summary totals do not include confidential plants.
(2) Load is less than or equal to 0.05 ton/year.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT COATING-GALVANIZING
## STRIP, SHEET AND MISCELLANEOUS PRODUCTS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 15.3 | 15.2 | 12.5 | 3.5 | 0 |
| Dissolved Iron | 210.3 | 16.5 | 13.5 | 1.9 | - |
| Hexavalent Chromium | 12.9 | 0.2 | 0.1 | (2) | - |
| Oil and Grease | 857.5 | 72.4 | 59.5 | 7.5 | - |
| Total Suspended Solids | 1,807.2 | 391.6 | 322.1 | 36.9 | - |
| Total Toxic Metals | 1,747.2 | 8.1 | 6.6 | 1.2 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 21.58 | 0.63 | 9.92 | 73.8 |
| Annual | - | 3.36 | 0.09 | 1.27 | 12.11 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.7 | 1.7 | 1.5 | 0.4 | 0 |
| Dissolved Iron | 25.0 | 1.9 | 1.6 | 0.2 | - |
| Hexavalent Chromium | 1.5 | (2) | (2) | (2) | - |
| Oil and Grease | 100.0 | 8.2 | 7.1 | 0.9 | - |
| Total Suspended Solids | 208.3 | 44.6 | 38.3 | 4.3 | - |
| Total Toxic Metals | 206.5 | 0.9 | 0.8 | 0.1 | - |
| Total Organics | - | - | - | - | - |

| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) | | | | | |
|---|---|---|---|---|---|
| Investment | - | 1.16 | 0.012 | 0.61 | 4.03 |
| Annual | - | 0.17 | 0.002 | 0.078 | 0.61 |

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(1) The cost summary totals do not include confidential plants.
(2) Load is less than or equal to 0.05 ton/year.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT COATING-GALVANIZING
## WIRE PRODUCTS AND FASTENERS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 5.3 | 5.3 | 3.9 | 1.2 | 0 |
| Dissolved Iron | 40.6 | 5.8 | 4.2 | 0.6 | - |
| Hexavalent Chromium | 0.8 | 0.1 | (2) | (2) | - |
| Oil and Grease | 110.1 | 25.4 | 18.4 | 2.5 | - |
| Total Suspended Solids | 359.3 | 137.6 | 99.6 | 12.3 | - |
| Total Toxic Metals | 63.1 | 2.8 | 2.0 | 0.4 | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1) | | | | | |
| Investment | - | 7.86 | 0.08 | 1.42 | 28.2 |
| Annual | - | 1.07 | 0.011 | 0.19 | 4.09 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 5.4 | 5.4 | 3.7 | 1.1 | 0 |
| Dissolved Iron | 38.3 | 5.8 | 4.0 | 0.6 | - |
| Hexavalent Chromium | 0.8 | 0.1 | (2) | (2) | - |
| Oil and Grease | 105.3 | 25.7 | 17.5 | 2.5 | - |
| Total Suspended Solids | 346.3 | 138.8 | 94.6 | 12.1 | - |
| Total Toxic Metals | 59.4 | 2.9 | 2.0 | 0.4 | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1) | | | | | |
| Investment | - | 3.23 | 0.07 | 0.90 | 16.21 |
| Annual | - | 0.48 | 0.010 | 0.12 | 2.38 |

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(1) The cost summary totals do not include confidential plants.
(2) Load is less than or equal to 0.05 ton/year.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT COATING-TERNE
## ALL PRODUCTS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 1.3 | 1.3 | 0.94 | 0.28 | 0 |
| Dissolved Iron | 39.0 | 1.4 | 1.0 | 0.2 | - |
| Oil and Grease | 30.8 | 6.2 | 4.5 | 0.6 | - |
| Tin | 3.1 | 0.7 | 0.5 | (1) | - |
| Total Suspended Solids | 76.9 | 33.8 | 24.3 | 3.0 | - |
| Total Toxic Metals | 9.5 | 0.8 | 0.5 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 2.21 | 0.16 | 0.95 | 9.34 |
| Annual | - | 0.33 | 0.02 | 0.12 | 1.34 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.22 | 0.22 | 0.22 | 0.055 | 0 |
| Dissolved Iron | 9.5 | 0.2 | 0.2 | (1) | - |
| Oil and Grease | 7.1 | 1.0 | 1.0 | 0.1 | - |
| Tin | 0.7 | 0.1 | 0.1 | (1) | - |
| Total Suspended Solids | 17.8 | 5.6 | 5.6 | 0.6 | - |
| Total Toxic Metals | 2.3 | 0.1 | 0.1 | (1) | - |
| Total Organics | - | - | - | - | - |
| **SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)** | | | | | |
| Investment | - | 0.07 | - | 0.03 | 0.29 |
| Annual | - | 0.01 | - | 0.003 | 0.04 |

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(1) Load is less than or equal to 0.05 ton/year.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT COATING-OTHER METALLIC COATINGS
## STRIP, SHEET AND MISCELLANEOUS PRODUCTS

|  | DIRECT DISCHARGERS |  |  |  |  |
|---|---|---|---|---|---|
| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
| Flow (MGD) | 0.9 | 0.9 | 0.9 | 0.23 | 0 |
| Aluminum | 29.6 | 1.0 | 1.0 | (1) | - |
| Dissolved Iron | 29.6 | 1.0 | 1.0 | (1) | - |
| Oil and Grease | 59.2 | 4.3 | 4.3 | 0.5 | - |
| Tin | 7.9 | 0.5 | 0.5 | (1) | - |
| Total Suspended Solids | 394.9 | 23.2 | 23.2 | 2.4 | - |
| Total Toxic Metals | 9.3 | 0.5 | 0.5 | 0.1 | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) |  |  |  |  |  |
| Investment | - | 1.72 | - | 0.50 | 6.50 |
| Annual | - | 0.27 | - | 0.06 | 0.94 |

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Note: There are no indirect dischargers in this segment. Also, since none of the plants have fume scrubbers, the BAT-1 discharge loads are identical with the BPT/BCT loads.

(1) Load is less than or equal to 0.05 ton/year.

## SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
## HOT COATING-OTHER METALLIC COATINGS
## WIRE PRODUCTS AND FASTENERS

### DIRECT DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | BPT/BCT | BAT-1 | BAT-2 | BAT-3 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.07 | 0.07 | 0.07 | 0.02 | 0 |
| Aluminum | 1.6 | 0.1 | 0.1 | (1) | - |
| Dissolved Iron | 2.3 | 0.1 | 0.1 | (1) | - |
| Oil and Grease | 2.3 | 0.3 | 0.3 | (1) | - |
| Tin | 0.2 | (1) | (1) | (1) | - |
| Total Suspended Solids | 19.5 | 1.9 | 1.9 | 0.2 | - |
| Total Toxic Metals | 0.2 | (1) | (1) | (1) | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)$^{(1)}$ | | | | | |
| Investment | - | 0.31 | - | 0.04 | 1.93 |
| Annual | - | 0.04 | - | 0.005 | 0.25 |

### INDIRECT (POTW) DISCHARGERS

| SUBCATEGORY LOAD SUMMARY (TONS/YEAR) | RAW WASTE | PSES-1 | PSES-2 | PSES-3 | PSES-4 |
|---|---|---|---|---|---|
| Flow (MGD) | 0.14 | 0.14 | 0.14 | 0.04 | 0 |
| Aluminum | 3.1 | 0.2 | 0.2 | (1) | - |
| Dissolved Iron | 4.7 | 0.2 | 0.2 | (1) | - |
| Oil and Grease | 4.7 | 0.7 | 0.7 | 0.1 | - |
| Tin | 0.3 | 0.1 | 0.1 | (1) | - |
| Total Suspended Solids | 39.1 | 3.7 | 3.7 | 0.4 | - |
| Total Toxic Metals | 0.4 | 0.1 | 0.1 | (1) | - |
| Total Organics | - | - | - | - | - |
| SUBCATEGORY COST SUMMARY ($\$X10^{-6}$) | | | | | |
| Investment | - | 0.51 | - | 0.04 | 2.44 |
| Annual | - | 0.07 | - | 0.006 | 0.32 |

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(1) Load is less than or equal to 0.05 ton/year.

## VOLUME I

## APPENDIX D

## STEEL INDUSTRY WASTEWATER POLLUTANTS

Acrylonitrile (3). Acrylonitrile ($CH_2$=CHCN) is an explosive flammable liquid having a normal boiling point of 77°C and a vapor pressure of 80 mmHg at 20°C. It is miscible with most organic solvents. It is manufactured by the reaction of propylene with ammonia and oxygen in the presence of a catalyst. Annual U.S. production is eight hundred thousand tons.

The major use of acrylonitrile is in the manufacture of copolymers for the production of acrylic and modacrylic fibers. It is also used in the plastics, surface coatings, and adhesives industries.

The acute toxicity of acrylonitrile is well known. The compound appears to exert part of its toxic effect through the release of inorganic cyanide. Inhalation has been reported to be the major route of exposure in lethal cases of acrylonitrile poisoning. Toxic manifestations of acrylonitrile inhalation include disorders of the central nervous system and chronic upper respiratory tract irritation. The next most likely route of exposure is dermal. Dermatologic conditions include contact allergic dermatitis, occupational eczema and toxodermia. The least likely route of exposure of acrylonitrile is through ingestion. Ingestion usually occurs through exposure to water or aquatic life containing acrylonitrile or exposure to food products packaged in materials which leach acrylonitrile to the food.

There is suggestive evidence that acrylonitrile is carcinogenic to humans and animals. NIOSH 1978 states, "...acrylonitrile must be handled in the workplace as a suspect human carcinogen." Laboratory rats which had acrylonitrile administered to them through inhalation and drinking water developed central nervous system tumors and zymbal gland carcinomas not evident in the control animals. Numerous reports have been made of the embryotoxicity, mutagenicity, and teratogenicity of acrylonitrile in laboratory animals.

For the maximum protection of human health from the potential carcinogenic effects of exposure to acrylonitrile through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of acrylonitrile estimated to result in additional lifetime cancer risk at levels of $10^{-7}$, $10^{-6}$ and $10^{-5}$ are 5.79 x $10^{-6}$ mg/l, 5.79 x $10^{-5}$ mg/l and 5.79 x $10^{-4}$ mg/l, resepctively. If contaminated aquatic organisms alone are consumed excluding the consumption of water, the water concentration should be less than 6.52 x $10^{-3}$ mg/l to keep the lifetime cancer risk below $10^{-5}$. Limited acute and chronic toxicity data for fresh water aquatic

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life show that adverse effects occur at concentrations higher than those cited for human health risks.

Some studies have been reported regarding the behavior of acrylonitrile in POTW. Biochemical oxidation of acrylonitrile under laboratory conditions at concentrations of 86-162 mg/l, produced 0, 2, and 56 percent degradation in 5, 10, and 20 days, respectively, using unacclimated seed cultures. Degradation of 72 percent was produced in 10 days using acclimated seed cultures. Based on these data and general conclusions relating molecular structure to biochemical oxidation, it is expected that acrylonitrile will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Other reports suggest that acrylonitrile entering an activated sludge process in concentrations of 50 ppm or greater, may inhibit certain bacterial processes such as nitrification.

Benzene (4). Benzene ($C_6H_6$) is a clear, colorless, liquid obtained mainly from petroleum feedstocks by several different processes. Some is recovered from light oil obtained from coal carbonization gases. It boils at 80°C and has a vapor pressure of 100 mm Hg at 26°C. It is slightly soluble in water (1.8 g/l at 25°C) and it disolves in hydrocarbon solvents. Annual U.S. production is three to four million tons.

Most of the benzene used in the U.S. goes into chemical manufacture. About half of that is converted to ethylbenzene which is used to make styrene. Some benzene is used in motor fuels.

Benzene is harmful to human health according to numerous published studies. Most studies relate effects of inhaled benzene vapors. These effects include nausea, loss of muscle coordination, and excitement, followed by depression and coma. Death is usually the result of respiratory or cardiac failure. Two specific blood disorders are related to benzene exposure. One of these, acute myelogenous leukemia, represents a carcinogenic effect of benzene. However, most human exposure data are based on exposure in occupationed settings and benzene carcinogenisis is not considered to be firmly established.

Oral administration of benzene to laboratory animals produced leukopenia, a reduction in number of leukocytes in the blood. Subcutaneous injection of benzene-oil solutions has produced suggestive, but not conclusive, evidence of benzene carcinogenisis.

Benzene demonstrated teratogenic effects in laboratory animals, and mutagenic effects in humans and other animals.

For maximum protection of human health from the potential carcinogenic effects of exposure to benzene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of benzene estimated to result in additional lifetime cancer risk at levels of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are $8 \times 10^{-5}$ mg/l, $8 \times 10^{-4}$ mg/l, and $8 \times 10^{-3}$ mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 0.478 mg/l to keep the lifetime cancer risk below $10^{-5}$. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Some studies have been reported regarding the behavior of benzene in POTW. Biochemical oxidation of benzene under laboratory conditions, at concentrations of 3 to 10 mg/l, produced 24, 27, 24, and 29 percent degradation in 5, 10, 15, and 20 days, respectively, using unacclimated seed cultures in fresh water. Degradation of 58, 67, 76, and 80 percent was produced in the same time periods using acclimated seed cultures. Other studies produced similar results. Based on these data and general conclusions relating molecular structure to biochemical oxidation, it is expected that benzene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Other reports indicate that most benzene entering a POTW is removed to the sludge and that influent concentrations of 1 g/l inhibit sludge digestion. An EPA study of the fate of toxic pollutants in POTW reveals removal efficiencies of 70 to 98 percent for three POTW where influent benzene levels were $5 \times 10^{-3}$ to $143 \times 10^{-3}$ mg/l. Four other POTW samples had influent benzene concentrations of 1 or $2 \times 10^{-3}$ mg/l and removals appeared indeterminate because of the limits of quantification for analyses. There is no information about possible effects of benzene on crops grown in soils amended with sludge containing benzene.

Hexachlorobenzene (9). Hexachlorobenzene ($C_6Cl_6$) is a nonflammable crystalline substance which is virtually insoluble in water. However, it is soluble in benzene, chloroform, and ether. Hexachlorobenzene (HCB) has a density of 2.044 g/ml. It melts at 231°C and boils at 323-326°C. Commercial production of HCB in the U.S. was discontinued in 1976, though it is still generated as a by-product of other chemical operations. In 1972, an estimated 2425 tons of HCB were produced in this way.

Hexachlorobenzene is used as a fungicide to control fungal diseases in cereal grains. The main agricultural use of HCB is on wheat seed intended soley for planting. HCB has been used as an impurity in other pesticides. It is used in industry as a plasticizer for polyvinyl chloride as well as a flame retardant. HCB is also used as a starting material for the production of pentachlorophenol which is marketed as a wood preservative.

Hexachlorobenzene can be harmful to human health as was seen in Turkey from 1955-1959. Wheat that had been treated with HCB in preparation for planting was consumed as food. Those people affected by HCB developed cutanea tarda porphyria, the symptoms of which included blistering and epidermolysis of the exposed parts of the body, particularly the face and the hands. These symptoms disappeared after consumption of HCB contaminated bread was discontinued. However, the HCB which was stored in body fat contaminated maternal milk. As a result of this, at least 95 percent of the infants feeding on this milk died. The fact that HCB remains stored in body fat after exposure has ended presents an additional problem. Weight loss may result in a dramatic redistribution of HCB contained in fatty tissue. If the stored levels of HCB are high, adverse effects might ensue.

Limited testing suggests that hexachlorobenzene is not teratogenic or mutagenic. However, two animal studies have been conducted which indicate that HCB is a carcinogen. HCB appears to have multipotential carcinogenic activity; the incidence of hepatomas, haemangioendotheliomas and thyroid adenomas was significantly increased in animals exposed to HCB by comparison to control animals.

For maximum protection of human health from the potential carcinogenic effects of exposure to hexachlorobenzene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of HCB estimated to result in additional lifetime cancer risk at levels of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are 7.2 x $10^{-8}$ mg/l, 7.2 x $10^{-6}$mg/l, and 7.2 x $10^{-6}$ mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 7.4 x $10^{-6}$ mg/l keep the increased lifetime cancer risk below $10^{-5}$. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

No detailed study of hexachlorobenzene behavior in POTW is available. However, general observations relating molecular structure to ease of degradation have been developed for all of the organic toxic pollutants. The conclusion reached by study of the limited data is that biological treatment produces little or no degradation of hexachlorobenzene. No evidence is available for drawing conclusions regarding its possible toxic or inhibitory effect on POTW operations.

1,1,1-Trichloroethane(11). 1,1,1-Trichloroethane is one of the two possible trichlorethanes. It is manufactured by hydrochlorinating vinyl chloride to 1,1-dichloroethane which is then chlorinated to the desired product. 1,1,1-Trichloroethane is a liquid at room temperature with a vapor pressure of 96 mm Hg at 20°C and a boiling point of 74°C. Its formula is $CCl_3CH_3$. It is slightly soluble in water (0.48 g/l) and is very soluble in organic solvents. U.S. annual production is greater than one-third of a million tons.

1,1,1-Trichloroethane is used as an industrial solvent and degreasing agent.

Most human toxicity data for 1,1,1-trichloroethane relates to inhalation and dermal exposure routes. Limited data are available for determining toxicity of ingested 1,1,1-trichloroethane, and those data are all for the compound itself not solutions in water. No data are available regarding its toxicity to fish and aquatic organisms. For the protection of human health from the toxic properties of 1,1,1-trichloroethane ingested through the consumption of water and fish, the ambient water criterion is 18.4 mg/l. If aquatic organisms alone are consumed, the water concentration should be less than 1030 mg/l. Available data show that adverse effects in aquatic species can occur at 18 mg/l.

No detailed study of 1,1,1-trichloroethane behavior in POTW is available. However, it has been demonstrated that none of the organic priority pollutants of this type can be broken down by biological treatment processes as readily as fatty acids, carbohydrates, or proteins.

Biochemical oxidation of many of the organic priority pollutants has been investigated, at least in laboratory scale studies, at concentrations higher than commonly expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. From study of the limited data, it is expected that 1,1,1-trichloroethane will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. No evidence is available for drawing conclusions about its possible toxic or inhibitory effect on POTW operation. However, for degradation to occur a fairly constant input of the compound would be necessary.

Its water solubility would allow 1,1,1-trichloroethane, present in the influent and not biodegradable, to pass through a POTW into the effluent. One factor which has received some attention, but no detailed study, is the volatilization of the lower molecular weight organics from POTW. If 1,1,1-trichloroethane is not biodegraded, it will volatilize during aeration processes in the POTW.

2,4,6-Trichlorophenol(21). 2,4,6-Trichlorophenol ($Cl_3C_6H_2OH$, abbreviated here to 2,4,6 TCP) is a colorless crystalline solid at room temperature. It is prepared by the direct chlorination of phenol. 2,4,6-TCP melts at 68°C and is slightly soluble in water (0.8 gm/l at 25°C). This phenol does not produce a color with 4-aminoantipyrene, therefore does not contribute to the nonconventional pollutant parameter "Total Phenols." No data were found on production volumes.

2,4,6-TCP is used as a fungicide, bactericide, glue and wood preservative, and for antimildew treatment. It is also used for the manufacture of 2,3,4,6-tetrachlorophenol and pentachlorophenol.

No data were found on human toxicity effects of 2,4,6-TCP. Reports of studies with laboratory animals indicate that 2,4,6-TCP produced convulsions when injected interperitoneally. Body temperature was also elevated. The compound also produced inhibition of ATP production in isolated rat liver mitochondria, increased mutation rate in one strain of bacteria, and produced a genetic change in rats. No studies on teratogenicity were found.

For the maximum protection of human health from the potential carcinogenic effects of exposure to 2,4,6-trichlorophenol through ingestion of water and contaminated aquatic organisms, the ambient water concentration should be zero. The estimated levels which would result in increased lifetime cancer risks of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are $1.18 \times 10^{-5}$ mg/l, $1.18 \times 10^{-4}$ mg/l, and $1.18 \times 10^{-3}$ mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than $3.6 \times 10^{-3}$ mg/l to keep the increased lifetime cancer risk below $10^{-5}$. Available data show that adverse effects in aquatic species can occur at $9.7 \times 10^{-4}$ mg/l.

Although no data were found regarding the behavior of 2,4,6-TCP in POTW, studies of the biochemical oxidation of the compound have been made in a laboratory scale at concentrations higher than those normally expected in municipal wastewaters. Biochemical oxidation of 2,4,6-TCP at 100 mg/l produced 23 percent degradation using a phenol-adapted acclimated seed culture. Based on these results, it is expected that 2,4,6-TCP will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Another study indicates that 2,4,6-TCP may be produced in POTW by chlorination of phenol during normal chlorination treatment.

Para-chloro-meta-cresol(22). Para-chloro-meta-cresol ($ClC_7H_6OH$) is thought to be 4-chloro-3-methyl-phenol (4-chloro-meta-cresol, or 2 chloro-5-hydroxy-toluene), but is also used by some authorities to refer to 6-chloro-3-methyl-phenol (6-chloro-meta-cresol, or 4-chloro-3-hydroxy-toluene), depending on whether the chlorine is considered to be para to the methyl or to the hydroxy group. It is assumed for the purposes of this document that the subject compound is 2-chloro-5-hydroxy-toluene. This compound is a colorless crystalline solid melting at 66-68°C. It is slightly soluble in water (3.8 gm/l) and soluble in organic solvents. This phenol reacts with 4-aminoantipyrene to give a colored product and therefore contributes to the nonconventional pollutant parameter designated "Total Phenols." No information on manufacturing methods or volumes produced was found.

Para-chloro-meta cresol (abbreviated here as PCMC) is marketed as a microbicide, and was proposed as an antiseptic and disinfectant, more than forty years ago. It is used in glues, gums, paints, inks, textiles, and leather goods. PCMC was found in raw wastewaters from the die casting quench operation from one subcategory of foundry operations.

Although no human toxicity data are available for PCMC, studies on laboratory animals have demonstrated that this compound is toxic when administered subcutaneously and intravenously. Death was preceeded by severe muscle tremors. At high dosages kidney damage occurred. On the other hand, an unspecified isomer of chlorocresol, presumed to be PCMC, is used at a concentration of 0.15 percent to preserve mucous heparin, a natural product administered intervenously as an anticoagulant. The report does not indicate the total amount of PCMC typically received. No information was found regarding possible teratogenicity, or carcinogenicity of PCMC. Based on available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 3 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.03 mg/l.

Two reports indicate that PCMC undergoes degradation in biochemical oxidation treatments carried out at concentrations higher than are expected to be encountered in POTW influents. One study showed 59 percent degradation in 3.5 hours when a phenol-adapted acclimated seed culture was used with a solution of 60 mg/l PCMC. The other study showed 100 percent degradation of a 20 mg/l solution of PCMC in two weeks in an aerobic activated sludge test system. No degradation of PCMC occurred under anaerobic conditions. From a review of limited data, it is expected that PCMC will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

Chloroform(23). Chloroform is a colorless liquid manufactured commercially by chlorination of methane. Careful control of conditions maximizes chloroform production, but other products must be separated. Chloroform boils at 61°C and has a vapor pressure of 200 mm Hg at 25°C. It is slightly soluble in water (8.22 g/l at 20°C) and readily soluble in organic solvents.

Chloroform is used as a solvent and to manufacture refrigerents, pharmaceuticals, plastics, and anesthetics. It is seldom used as an anesthetic.

Toxic effects of chloroform on humans include central nervous system depression, gastrointestinal irritation, liver and kidney damage and possible cardiac sensitization to adrenalin. Carcinogenicity has been demonstrated for chloroform on laboratory animals.

For the maximum protection of human health from the potential carcinogenic effects of exposure to chloroform through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of chloroform estimated to result in additional lifetime cancer risks at the levels of $10^{-7}$, $10^{-6}$, and $10^{-5}$ were $1.89 \times 10^{-5}$ mg/l, $1.89 \times 10^{-4}$ mg/l, and $1.89 \times 10^{-3}$ mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 0.157 mg/l to keep the increased lifetime cancer risk below $10^{-5}$. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Few data are available regarding the behavior of chloroform in a POTW. However, the biochemical oxidation of this compound was studied in one laboratory scale study at concentrations higher than those expected to be contained by most municipal wastewaters. After 5, 10, and 20 days no degradation of chloroform was observed. The conclusion reached is that biological treatment produces little or no removal by degradation of chloroform in POTW. An EPA study of the fate of toxic pollutants in POTW reveals removal efficiencies of 0 to 80 percent for influent concentrations ranging from 5 to $46 \times 10^{-3}$ mg/l at seven POTW.

The high vapor pressure of chloroform is expected to result in volatilization of the compound from aerobic treatment steps in POTW. Remaining chloroform is expected to pass through into the POTW effluent.

2-Chlorophenol(24). 2-Chlorophenol ($ClC_6H_4OH$), also called ortho-chlorophenol, is a colorless liquid at room temperature, manufactured by direct chlorination of phenol followed by distillation to separate it from the other principal product, 4-chlorophenol. 2-Chlorophenol solidifies below 7°C and boils at 176°C. It is soluble in water (28.5 gm/l at 20°C) and soluble in several types of organic solvents. This phenol gives a strong color with 4-aninoantipyrene and therefore contributes to the nonconventional pollutant parameter "Total Phenols." Production statistics could not be found. 2-Chlorophenol is used almost exclusively as a chemical intermediate in the production of pesticdes and dyes. Production of some phenolic resins uses 2-chlorophenol.

Very few data are available on which to determine the toxic effects of 2-chlorophenol on humans. The compound is more toxic to laboratory mammals when administered orally than when administered subcataneously or intravenously. This affect is attributed to the fact that the compound is almost completely in the un-ionized state at the low pH of the stomach and hence is more readily absorbed into the body. Initial symptoms are restlessness and increased respiration rate, followed by motor weakness and convulsions induced by noise or touch. Coma follows. Following lethal doses, kidney, liver, and intestinal damage were observed. No studies were found which addressed the teratogenicity or mutagenicity of 2-chlorophenol. Studies of 2-chlorophenol as a promoter of carcinogenic activity of other carcinogens were conducted by dermal application. Results do not bear a determinable relationship to results of oral administration studies.

For controlling undesirable taste and odor quality of ambient water due to the organoleptic properties of 2-chlorophenol in water, the estimated level is $1 \times 10^{-4}$ mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than that cited for organaleptic effects.

Data on the behavior of 2-chlorophenol in POTW are not available. However, laboratory scale studies have been conducted at concentrations higher than those expected to be found in municipal wastewaters. At 1 mg/l of 2-chlorophenol, an acclimated culture produced 100 percent degradation by biochemical oxidation after 15 days. Another study showed 45, 70, and 79 percent degradation by biochemical oxidation after 5, 10, and 20 days, respectively. From study of these limited data, and general observations on all organic priority pollutants relating molecular structure to ease of biochemical oxidation, it is expected that 2-chlorophenol will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Undegraded 2-chlorophenol is expected to pass through POTW into the effluent because of the water solubility. Some 2-chlorophenol is also expected to be generated by chlorination treatments of POTW effluents containing phenol.

2,4-Dimethylphenol(34). 2,4-Dimethylphenol (2,4-DMP), also called 2,4-xylenol, is a colorless, crystalline solid at room temperature (25°C), but melts at 27 to 28°C. 2,4-DMP is slightly soluble in water and, as a weak acid, is soluble in alkaline solutions. Its vapor pressure is less than 1 mm Hg at room temperature.

2,4-DMP is a natural product, occurring in coal and petroleum sources. It is used commercially as a intermediate for manufacture of pesticides, dystuffs, plastics and resins, and surfactants. It is found in the water runoff from asphalt surfaces. It can find its way into the wastewater of a manufacfuring plant from any of several adventitious sources.

Analytical procedures specific to this compound are used for its identification and quantification in wastewaters. This compound does not contribute to "Total Phenol" determined by the 4-aminoantipyrene method.

Three methylphenol isomers (cresols) and six dimethylphenol isomers (xylenols) generally occur together in natural products, industrial processes, commercial products, and phenolic wastes. Therefore, data are not available for human exposure to 2,4-DMP alone. In addition to this, most mammalian tests for toxicity of individual dimethylphenol isomers have been conducted with isomers other than 2,4-DMP.

In general, the mixtures of phenol, methylphenols, and dimethylphenols contain compounds which produced acute poisoning in laboratory animals. Symptoms were difficult breathing, rapid muscular spasms, disturbance of motor coordination, and assymetrical body position. In a 1977 National Academy of Science publication the conclusion was reached that, "In view of the relative paucity of data on the mutagenicity, carcinogenicity, teratogenicity, and long term oral toxicity of 2,4 dimethylphenol, estimates of the effects of chronic oral exposure at low levels cannot be made with any confidence." No ambient water quality criterion can be set at this time. In order to protect public health, exposure to this compound should be minimized as soon as possible.

Toxicity data for fish and freshwater aquatic life are limited. Acute toxicity to freshwater aquatic life occurs at 2,4-dimethylphenol concentrations of 2.12 mg/l. For controlling undesirable taste and odor quality of ambient water due to the organoleptic effects of 2,4-dimethylphenol in water the estimated level is 0.4 mg/l.

The behavior of 2,4-DMP in POTW has not been studied. As a weak acid its behavior may be somewhat dependent on the pH of the influent to the POTW. However, over the normal limited range of POTW pH, little effect of pH would be expected.

Biological degradability of 2,4-DMP as determined in one study, showed 94.5 percent biochemical oxidation after 110 hours using an adapted culture. Thus, it is expected that 2,4-DMP will be biochemically oxidized to about the same extent as domestic sewage by biological treatment in POTW. Another study determined that persistance of 2,4-DMP in the environment is low, thus any of the compound which remained in the sludge or passed through the POTW into the effluent would be degraded within moderate length of time (estimated as 2 months in the report).

2,4-Dinitrotoluene(35). 2,4-Dinitrotoluene $[(NO_2)_2C_6H_3CH_3]$, a yellow crystalline compound, is manufactured as a coproduct with the 2,6 isomer by nitration of nitrotoluene. It melts at 71°C. 2,4-Dinitrotoluene is insoluble in water (0.27 g/l at 22°C) and soluble in a number of organic solvents. Production data for the 2,4-isomer alone are not available. The 2,4-and 2,6-isomers are manufactured in an 80:20 or 65:35 ratio, depending on the process used. Annual U.S. commercial production is about 150 thousand tons of the two isomers. Unspecified amounts are produced by the U.S. government and further nitrated to trinitrotoluene (TNT) for military use.

The major use of the dinitrotoluene mixture is for production of toluene diisocyanate used to make polyurethanes. Another use is in production of dyestuffs.

The toxic effect of 2,4-dinitrotoluene in humans is primarily methemoglobinemia (a blood condition hindering oxygen transport by the blood). Symptoms depend on severity of the disease, but include cyanosis, dizziness, pain in joints, headache, and loss of appetite in workers inhaling the compound. Laboratory animals fed oral doses of 2,4-dinitrotoluene exhibited many of the same symptoms. Aside from the effects in red blood cells, effects are observed in the nervous system and testes.

Chronic exposure to 2,4-dinitrotoluene may produce liver damage and reversible anemia. No data were found on teratogenicity of this compound. Mutagenic data are limited and are regarded as confusing. Data resulting from studies of carcinogenicity of 2,4-dinitrotoluene point to a need for further testing for this property.

For the maximum protection of human health from the potential carcinogenic effects of exposure to 2,4-dinitrotoluene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of 2,4-dinitrotoluene estimated to result in additional lifetime cancer risk at risk levels of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are $1.11 \times 10^{-5}$ mg/l, $1.11 \times 10^{-4}$ mg/l, and $1.11 \times 10^{-3}$ mg/l, respectively. If aquatic organisms alone are consumed, the water concentration should be less than 0.091 mg/l to keep the increased lifetime cancer risk below $10^{-5}$. Available data show that adverse effects in aquatic life occur at concentrations higher than those cited for human health risks.

Data on the behavior of 2,4-dinitrotoluene in POTW are not available. However, biochemical oxidation of 2,4-dinitrotoluene was investigated on a laboratory scale. At 100 mg/l of 2,4-dinitrotoluene, a concentration considerably higher than that expected in municipal wastewaters, biochemical oxidation by an acclimated, phenol-adapted seed culture produced 52 percent degradation in three hours. Based on this limited information and general observations relating molecular structure to ease of degradation for all the organic toxic pollutants, it is expected that 2,4-dinitrotoluene will be biochemically oxidized to about the same extent as domestic sewage by biological treatment in POTW. No information is available regarding possible interference by 2,4-dinitrotoluene in POTW treatment processes, or on the possible detrimental effect on sludge used to amend soils in which food crops are grown.

2,6-Dinitrotoluene(36). 2,6-Dinitrotoluene $[(NO_2)_2C_6H_3CH_3]$ is a crystalline solid produced as a coproduct with 2,4-dinitrotoluene by nitration of nitrotoluene. It melts at 66C. No solubility or vapor pressure data are given in the literature, but this compound is expected to be insoluble just as the 2,4-dinitrotoluene isomer is (0.27 g/l at 22C). Production data for the 2,6-isomer are not available. The 2,4- and 2,6- isomers are manufactured in an 80:20 or 65:35 ratio depending on the process used. Annual U.S. commercial production is about 150 thousand tons of the two isomers. Unspecified amounts are produced by the U.S. government and further nitrated to trinitrotoluene (TNT) for military use.

The major use of the dinitrotoluene mixture is for production of toluene diisocyanate used to make polyurethanes. Another use is in production of dyestuffs.

No toxicity data are available in the literature for 2,6-dinitrotoluene. The 2,4-isomer is toxic and is classed as a potential carcinogen on the basis of tumerogenic effects and other considerations. No ambient water criterion has been established for 2,6-dinitrotoluene.

Data on the behavior of 2,6-dinitrotoluene in POTW are not available. Biochemical oxidation of many of the organic priority pollutants have been investigated, at least in laboratory scale studies, at concentrations higher than those expected to be contained by most municipal wastewaters. General observations have been developed relating molecular structure to ease of degradation for all the organic toxic pollutants. Based upon study of the limited data, it is expected that 2,6-dinitrotoluene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. No information is available regarding possible interferance by 2,6-dinitrotoluene in POTW processes, or the possible detrimental effect on sludge used to amend soils in which crops are grown.

Ethylbenzene(38). Ethylbenzene is a colorless, flammable liquid manufactured commercially from benzene and ethylene. Approximately half of the benzene used in the U.S. goes into the manufacture of more than three million tons of ethylbenzene annually. Ethylbenzene boils at 136°C and has a vapor pressure of 7 mm Hg at 20°C. It is slightly soluble in water (0.14 g/l at 15°C) and is very soluble in organic solvents.

About 98 percent of the ethylbenzene produced in the U.S. goes into the production of styrene, much of which is used in the plastics and synthetic rubber industries. Ethylbenzene is a constituent of xylene mixtures used as diluents in the paint industry, agricultural insecticide sprays, and gasoline blends.

Although humans are exposed to ethylbenzene from a variety of sources in the environment, little information on effects of ethylbenzene in man or animals is available. Inhalation can irritate eyes, affect the respiratory tract, or cause vertigo. In laboratory animals ethylbenzene exhibited low toxicity. There are no data available on teratogenicity, mutagenicity, or carcinogenicity of ethylbenzene.

Criteria are based on data derived from inhalation exposure limits. For the protection of human health from the toxic properties of ethylbenzene ingested through water and contaminated aquatic organisms, the ambient water criterion is 1.4 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 3.28 mg/l. Available data show that at concentrations of 0.43 mg/l, adverse effects on aquatic life occur.

The behavior of ethylbenzene in POTW has not been studied in detail. Laboratory scale studies of the biochemical oxidation of ethylbenzene at concentrations greater than would normally be found in municipal wastewaters have demonstrated varying degrees of degradation. In one study with phenol-acclimated seed cultures 27 percent degradation was observed in a half day at 250 mg/l ethyl- bezene. Another study at unspecified conditions showed 32, 38, and 45 percent degradation after 5, 10, and 20 days, respectively. Based on these results and general observations relating molecular structure to ease of degradation, it is expected that ethylbenzene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW.

An EPA study of seven POTW showed removals of 77 to 100 percent in five POTW having influent ethylbenzene concentrations of 10 to 44 x $10^{-3}$ mg/l. The other two POTW had influent concentrations of 2 x $10^{-3}$ mg/l or less. Other studies suggest that most of the ethylbenzene entering a POTW is removed from the aqueous stream to the sludge. The ethylbenzene contained in the sludge removed from the POTW may volatilize.

Fluoranthene(39). Fluoranthene (1,2-benzacenaphthene) is one of the compounds called polynuclear aromatic hydrocarbons (PAH). A pale yellow solid at room temperature, it melts at 111°C and has a negligible vapor pressure at 25°C. Water solubility is low (0.2 mg/l). Its molecular formula is $C_{16}H_{10}$.

Fluoranthene, along with many other PAH's, is found throughout the environment. It is produced by pyrolytic processing of organic raw materials, such as coal and petroleum, at high temperature (coking processes). It occurs naturally as a product of plant biosyntheses. Cigarette smoke contains fluoranthene. Although it is not used as the pure compound in industry, it has been found at relatively higher concentrations (0.002 mg/l) than most other PAH's in at least one industrial effluent. Furthermore, in a 1977 EPA survey to determine levels of PAH in U.S. drinking water supplies, none of the 110 samples analyzed showed any PAH other than fluoranthene.

Experiments with laboratory animals indicate that fluoranthene presents a relatively low degree of toxic potential from acute exposure, including oral administration. Where death occured, no information was reported concerning target organs or specific cause of death.

There is no epidemiological evidence to prove that PAH in general, and fluoranthene, in particular, present in drinking water are related to the development of cancer. The only studies directed toward determining carcinogenicity of fluoranthene have been skin tests on laboratory animals. Results of these tests show that fluoranthene has no activity as a complete carcinogen (i.e., an agent which produces cancer when applied by itself, but exhibits significant cocarcinogenicity (i.e., in combination with a carcinogen, it increases the carcinogenic activity).

Based on the limited animal study data, and following an establishing procedure, the ambient water criterion for fluoranthene through water and contaminated aquatic organisms is determined to be 0.042 mg/l for the protection of human health from its toxic properties. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 0.054 mg/l. Available data show that adverse effects on aquatic life occur at concentrations of 0.016 mg/l.

Results of studies of the behavior of fluoranthene in conventional sewage treatment processes found in POTW have been published. Removal of fluoranthene during primary sedimentation was found to be 62 to 66 percent (from an initial value of 0.00323 to 0.0435 mg/l to a final value of 0.00122 to 0.0146 mg/l), and the removal was 91 to 99 percent (final values of 0.00028 to 0.00026 mg/l) after biological purification with activated sludge processes.

A review was made of data on biochemical oxidation of many of the organic priority pollutants investigated in laboratory scale studies at concentrations higher than would normally be expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. The conclusion reached by study of the limited data is that biological treatment produces little or no degradation of fluoranthene. The same study however concludes that fluoranthene would be readily removed by filtration and oil water separation and other methods which rely on water insolubility, or adsorption on other particulate surfaces. This latter conclusion is supported by the previously cited study showing significant removal by primary sedimentation.

No studies were found to give data on either the possible interference of fluoranthene with POTW operation, or the persistance of fluoranthene in sludges on POTW effluent waters. Several studies have documented the ubiquity of fluoranthene in the environment and it cannot be readily determined if this results from persistance of anthropogenic fluoranthene or the replacement of degraded fluoranthene by natural processes such as biosynthesis in plants.

Isophorone(54). Isophorone is an industrial chemical produced at a level of tens of millions of pounds annually in the U.S. The chemical name for isophorone is 3,5,5-trimethyl-2-cyclohexen-1-one and it is also known as trimethyl cyclohexanone and isoacetophorone. The formula is $C_6H_5(CH_3)_3O$. Normally, it is produced as the gamma isomer; technical grades contain about 3 percent of the beta isomer (3,5-5-trimethyl-3-cyclohexen-1-one). The pure gamma isomer is a water-white liquid, with vapor pressure less than 1 mm Hg at room temperature, and a boiling point of 215.2°C. It has a camphor- or peppermint-like odor and yellows upon standing. It is slightly soluble (12 mg/l) in water and dissolves in fats and oils.

Isophorone is synthesized from acetone and is used commercially as a solvent or cosolvent for finishes, lacquers, polyvinyl and nitrocellulose resins, pesticides, herbicides, fats, oils, and gums. It is also used as a chemical feedstock.

Because isophorone is an industrially used solvent, most toxicity data are for inhalation exposure. Oral administration to laboratory animals in two different studies revealed no acute or chronic effects during 90 days, and no hematological or pathological abnormalities were reported. Apparently, no studies have been completed on the carcinogenicity of isophorone.

Isophorone does undergo bioconcentration in the lipids of aquatic organisms and fish.

The ambient water criterion for isophorone ingested through consumption of water and fish is determined to be 5.2 mg/l for the protection of human health from its toxic properties. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criteria is 520 mg/l. Available data show that adverse effects in aquatic life occur at concentrations as low as 12.9 mg/l.

The behavior of isophorone in POTW has not been studied. However, the biochemical oxidation of many of the organic priority pollutants has been investigated in laboratory-scale studies at concentrations higher than would normally be expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. Based on the study of the limited data, it is expected that isophorone will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. This conclusion is consistant with the findings of an experimental study of microbiological degradation of isophorone which showed about 45 percent biooxidation in 15 to 20 days in domestic wastewater, but only 9 percent in salt water. No data were found on the persistance of isophorone in sewage sludge.

Naphthalene(55). Naphthalene is an aromatic hydrocarbon with two orthocondensed benzene rings and a molecular formula of $C_{10}H_8$. As such it is properly classed as a polynuclear aromatic hydrocarbon (PAH). Pure naphthalene is a white crystalline solid melting at 80°C. For a solid, it has a relatively high vapor pressure (0.05 mm Hg at 20°C), and moderate water solubility (19 mg/l at 20°C). Naphthalene is the most abundant single component of coal tar. Production is more than a third of a million tons annually in the U.S. About three fourths of the production is used as feedstock for phthalic anhydride manufacture. Most of the remaining production goes into manufacture of insecticide, dystuffs, pigments, and pharmaceuticals. Chlorinated and partially hydrogenated naphthalenes are used in some solvent mixtures. Naphthalene is also used as a moth repellent.

Naphthalene, ingested by humans, has reportedly caused vision loss (cataracts), hemolytic anemia, and occasionally, renal disease. These effects of naphthalene ingestion are confirmed by studies on laboratory animals. No carcinogenicity studies are available which can be used to demonstrate carcinogenic activity for naphthalene. Naphthalene does bioconcentrate in aquatic organisms.

The available data base is insufficient to establish an ambient water criterion for the protection of human health from the toxic properties of naphthalene. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.62 mg/l.

Only a limited number of studies have been conducted to determine the effects of naphthalene on aquatic organisms. The data from those studies show only moderate toxicity.

Naphthalene has been detected in sewage plant effluents at concentrations up to 22 µg/l in studies carried out by the U.S. EPA. Influent levels were not reported. The behavior of naphthalene in POTW has not been studied. However, recent studies have determined that naphthalene will accumulate in sediments at 100 times the concentration in overlying water. These results suggest that naphthalene will be readily removed by primary and secondary settling in POTW, if it is not biologically degraded.

Biochemical oxidation of many of the organic priority pollutants has been investigated in laboratory-scale studies at concentrations higher than would normally be expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. Based on the study of the limited data, it is expected that naphthalene will be biochemically oxidized to about the same extent as domestic sewage by biological treatment in POTW. One recent study has shown that microorganisms can degrade naphthalene, first to a dihydro compound, and ultimately to carbon dioxide and water.

2-Nitrophenol(57). 2-Nitrophenol ($NO_2C_6H_4OH$), also called ortho-nitrophenol, is a light yellow crystalline solid, manufactured commercially by hydrolysis of 2-chloro-nitrobenzene with aqueous sodium hydroxide. 2-Nitrophenol melts at 45ºC and has a vapor pressure of 1 mm Hg at 49ºC. 2-Nitrophenol is slightly soluble in water (2.1 g/l at 20ºC) and soluble in organic solvents. This phenol does not react to give a color with 4-aminoantipyrene, and therefore does not contribute to the nonconventional pollutant parameter "Total Phenols. U.S. annual production is five thousand to eight thousand tons.

The principal use of ortho-nitrophenol is to synthesize ortho-aminophenol, ortho-nitroanisole, and other dyestuff intermediates.

The toxic effects of 2-nitrophenol on humans have not been extensively studied. Data from experiments with laboratory animals indicate that exposure to this compound causes kidney and liver damage. Other studies indicate that the compound acts directly on cell membranes, and inhibits certain enzyme systems in vitro. No information regarding potential teratogencity was found. Available data indicate that this compound does not pose a mutagenic hazard to humans. Very limited data for 2-nitrophenol do not reveal potential carcinogenic effects.

The available data base is insufficient to establish an ambient water criterion for protection of human health from exposure to 2-nitrophenol. No data are available on which to evaluate the adverse effects of 2-nitrophenol on aquatic life.

Data on the behavior of 2-nitrophenol in POTW were not available. However, laboratory-scale studies have been conducted at concentrations higher than those expected to be found in municipal wastewater. Biochemical oxidation using adapted cultures from various sources produced 95 percent degradation in three to six days in one study. Similar results were reported for other studies. Based on these data, and general observations relating molecular structure to ease of biological oxidation, it is expected that 2-nitrophenol will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

4,6-dinitro-o-cresol(60). 4,6-dinitro-o-cresol (DNOC) is a yellow crystalline solid derived from o-cresol. DNOC melts at 85.8ºC and has a vapor pressure of 0.000052 mm Hg at 20ºC. DNOC is sparingly soluble in water (100 mg/l at 20ºC), while it is readily soluble in alkaline aqueous solutions, ether, acetone, and alcohol. DNOC is produced by sulfonation of o-cresol followed by treatment with nitric acid.

DNOC is used primarily as a blossom thinning agent on fruit trees and as a fungicide, insecticide and miticide on fruit trees during the dormant season. It is highly toxic to plants in the growing stage. DNOC is not manufactured in the U.S. as an agricultural chemical. Imports of DNOC have been decreasing recently with only 30,000 lbs being imported in 1976.

While DNOC is highly toxic to plants, it is also very toxic to humans and is considered to be one of the more dangerous agricultural pesticides. The available literature concerning humans indicates that DNOC may be absorbed in acutely toxic amounts through the respiratory and gastrointestinal tracts and through the skin, and that it accumulates in the blood. Symptoms of poisoning inlude profuse sweating, thirst, loss of weight, headache, malaise, and yellow staining to the skn, hair, sclera, and conjunctiva.

There is no evidence to suggest that DNOC is teratogenic, mutagenic, or carcinogenic. The effects of DNOC in the human due to chronic exposure are basically the same as those effects resulting from acute exposure. Although DNOC is considered a cumulative poison in humans, cataract formation is the only chronic effect noted in any human or experimental animal study. It is believed that DNOC accumulates in the human body and that toxic symptoms may develop when blood levels exceed 20 mg/kg.

For the protection of human health from the toxic properties of dinitro-o-cresol ingested through water and contaminanted aquatic organisms, the ambient water criterion is determined to be 0.0134 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is determined to be 0.765 mg/l. No data are available on which to evaluate the adverse effects of 4,6-dinitro-o-cresol on aquatic life.

Some studies have been reported regarding the behavior of DNOC in POTW. Biochemical oxidation of DNOC under laboratory conditions at a concentration of 100 mg/l produced 22 percent degradation in 3.5 hours, using acclimated phenol adapted seed cultures. In addition, the nitro group in the number 4 (para) position seems to impart a destabilizing effect on the molecule. Based on these data and general conclusions relating molecular structure to biochemical oxidation, it is expected that 4,6-dinitro-o-cresol will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW.

Pentachlorophenol(64). Pentachlorophenol ($C_6Cl_5OH$) is a white crystalline solid produced commercially by chlorination of phenol or polychlorophenols. U.S. annual production is in excess of 20,000 tons. Pentachlorophenol melts at 190°C and is slightly soluble in water (14 mg/l). Pentachlorophenol is not detected by the 4-amino antipyrene method.

Pentachlorophenol is a bactericide and fungacide and is used for preservation of wood and wood products. It is competative with creosote in that application. It is also used as a preservative in glues, starches, and photographic papers. It is an effective algicide and herbicide.

Although data are available on the human toxicity effects of pentachlorophenol, interpretation of data is frequently uncertain. Occupational exposure observations must be examined carefully because exposure to pentachlorophenol is frequently accompained by exposure to other wood preservatives. Additionally, experimental results and occupational exposure observations must be examined carefully to make sure that observed effects are produced by the pentachlorophenol itself and not by the by-products which usually contaminate pentachlorophenol.

Acute and chronic toxic effects of pentachlorophenol in humans are similar; muscle weakness, headache, loss of appetite, abdominal pain, weight loss, and irritation of skin, eyes, and respiratory tract. Available literature indicates that pentachlorophenol does not accumulate in body tissues to any significant extent. Studies on laboratory animals of distribution of the compound in body tissues showed the highest levels of pentachlorophenol in liver, kidney, and intestine, while the lowest levels were in brain, fat, muscle, and bone.

Toxic effects of pentachlorophenol in aquatic organisms are much greater at pH of 6 where this weak acid is predominantly in the undissociated form than at pH of 9 where the ionic form predominates. Similar results were observed in mammals where oral lethal doses of pentachlorophenol were lower when the compound was administered in hydrocarbon solvents (un-ionized form) than when it was administered as the sodium salt (ionized form) in water.

There appear to be no significant teratogenic, mutagenic, or carcinogenic effects of pentachlorophenol.

For the protection of human health from the toxic properties of pentachlorophenol ingested through water and through contaminated aquatic organisms, the ambient water quality criterion is determined to be 1.01 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is determined to be 29.4 mg/l. Available data show that adverse effects on aquatic life occur at concentration as low as 0.0032 mg/l.

Only limited data are available for reaching conclusions about the behavior of pentachlorophenol in POTW. Pentachlorophenol has been found in the influent to POTW. In a study of one POTW the mean removal was 59 percent over a 7 day period. Trickling filters removed 44 percent of the influent pentachlorophenol suggesting that biological degradation occurs. The same report compared removal of pentachlorophenol of the same plant and two additional POTW on a later date and obtained values of 4.4, 19.5 and 28.6 percent removal, the last value being for the plant which was 59 percent removal in the original study. Influent concentrations of pentachloropehnol ranged from 0.0014 to 0.0046 mg/l. Other studies, including the general review of data relating molecular structure to biological oxidation, indicate that pentachlorophenol is not biochemically oxidized by biological treatment processes in POTW. Anaerobic digestion processes are inhibited by 0.4 mg/l pentachlorophenol.

The low water solubility and low volatility of pentachloro- phenol lead to the expectation that most of the compound will remain in the sludge in a POTW. The effect on plants grown on land treated with sludge containing pentachlorophenol is unpredicatable. Laboratory studies show that this compound affects crop germination at 5.4 mg/l. However, photodecomposition of pentachlorophenol occurs in sunlight. The effects of the various breakdown products which may remain in the soil was not found in the literature.

Phenol(65). Phenol, also called hydroxybenzene and carbolic acid, is a clear, colorless, hygroscopic, deliquescent, crystalline solid at room temperature. Its melting point is 43°C and its vapor pressure at room temperature is 0.35 mm Hg. It is very soluble in water (67 gm/l at 16°C) and can be dissolved in benzene, oils, and petroleum solids. Its formula is $C_6H_5OH$.

Although a small percent of the annual production of phenol is derived from coal tar as a naturally occuring product, most of the phenol is synthesized. Two of the methods are fusion of benzene sulfonate with sodium hydroxide, and oxidation of cumene followed by clevage with a catalyst. Annual production in the U.S. is in excess of one million tons. Phenol is generated during distillation of wood and the microbiological decomposition of organic matter in the mammalian intestinal tract.

Phenol is used as a disinfectant, in the manufacture of resins, dyestuffs, and pharmaceuticals, and in the photo processing industry. Phenol was detected on only one day in one coil coating raw waste stream out of 14 days of sampling and analysis at 11 coil coating plants. In this discussion, phenol is the specific compound which is separated by methylene chloride extraction of an acidified sample and identified and quantified by GC/MS. Phenol also contributes to the "Total Phenols", discussed elsewhere which are determined by the 4-AAP colorimetric method.

Phenol exhibits acute and sub-acute toxicity in humans and laboratory animals. Acute oral doses of phenol in humans cause sudden collapse and un- consciousness by its action on the central nervous system. Death occurs by respiratory arrest. Sub-acute oral doses in mammals are rapidly absorbed then quickly distributed to various organs, then cleared from the body by urinary excretion and metabolism. Long term exposure by drinking phenol contaminated water has resulted in statistically significant increase in reported cases of diarrhea, mouth sores, and burning of the mouth. In laboratory animals long term oral administration at low levels produced slight liver and kidney damage. No reports were found regarding carcinogenicity of phenol administered orally - all carcinogenicity studies were skin tests.

For the protection of human health from phenol ingested through water and through contaminated aquatic organisms the ambient water criterion is determined to be 3.5 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 769 mg/l. Available data show that adverse effects in aquatic life occur at concentrations as low as 2.56 mg/l.

Data have been developed on the behavior of phenol in POTW. Phenol is biodegradable by biota present in POTW. The ability of a POTW to treat phenol-bearing influents depends upon acclimation of the biota and the constancy of the phenol concentration. It appears that an induction period is required to build up the population of organisms which can degrade phenol. Too large a concentration will result in upset or pass through in the POTW, but the specific level causing upset depends on the immediate past history of phenol concentrations in the influent. Phenol levels as high as 200 mg/l have been treated with 95 percent removal in POTW, but more or less continuous presence of phenol is necessary to maintain the population of microorganisms that degrade phenol. An EPA study of seven POTWs revealed that only three POTW showed a decrease in phenol concentration between influent (14, 1, and 1 x $10^{-3}$ mg/l) and effluent (1 x $10^{-3}$ mg/l, and 0, respectively).

Phenol which is not degraded is expected to pass through the POTW because of its very high water solubility. However, in POTW where chlorination is practiced for disinfection of the POTW effluent, chlorination of phenol may occur. The products of that reaction may be priority pollutants.

The EPA has developed data on influent and effluent concentrations of total phenols in a study of 103 POTW. However, the analytical procedure was the 4-AAP method mentioned earlier and not the GC/MS method specifically for phenol. Discussion of the study, which of course includes phenol, is presented under the pollutant heading "Total Phenols."

Phthalate Esters (66-71). Phthalic acid, or 1,2-benzenedicarboxylic acid, is one of three isomeric benzenedicarboxylic acids produced by the chemical industry. The other two isomeric forms are called isophthalic and terephathalic acids. The formula for all three acids is $C_6H_4(COOH)_2$. Some esters of phthalic acid are designated as toxic pollutants. They will be discussed as a group here, and specific properties of individual phthalate esters will be discussed afterwards.

Phthalic acid esters are manufactured in the U.S. at an annual rate in excess of 1 billion pounds. They are used as plasticizers - primarily in the production of polyvinyl chloride (PVC) resins. The most widely used phthalate plasticizer is bis (2-ethylhexyl) phthalate (66) which accounts for nearly one third of the phthalate esters produced. This particular ester is commonly referred to as dioctyl phthalate (DOP) and should not be confused with one of the less used esters, di-n-octyl phthalate (69), which is also used as a plastcizer. In addition to these two isomeric dioctyl phthalates, four other esters, also used primarily as plasticizers, are designated as priority pollutants. They are: butyl benzyl phthalate (67), di-n-butyl phthalate (68), diethyl phthalate (70), and dimethyl phthalate (71).

Industrially, phthalate esters are prepared from phthalic anhydride and the specific alcohol to form the ester. Some evidence is available suggesting that phthalic acid esters also may be synthesized by certain plant and animal tissues. The extent to which this occurs in nature is not known.

Phthalate esters used as plasticizers can be present in concentrations up to 60 percent of the total weight of the PVC plastic. The plasticizer is not linked by primary chemical bonds to the PVC resin. Rather, it is locked into the structure of intermeshing polymer molecules and held by van der Waals forces. The result is that the plasticizer is easily extracted. Plasticizers are responsible for the odor associated with new plastic toys or flexible sheet that has been contained in a sealed package.

Although the phthalate esters are not soluble or are only very slightly soluble in water, they do migrate into aqueous solutions placed in contact with the plastic. Thus industrial facilities with tank linings, wire and cable coverings, tubing, and sheet flooring of PVC are expected to discharge some phthalate esters in their raw waste. In addition to their use as plasticizers, phthalate esters are used in lubricating oils and pesticide carriers. These also can contribute to industrial discharge of phthalate esters.

From the accumulated data on acute toxicity in animals, phthalate esters may be considered as having a rather low order of toxicity. Human toxicity data are limited. It is thought that the toxic effects of the esters is most likely due to one of the metabolic products, in particular the monoester. Oral acute toxicity in animals is greater for the lower molecular weight esters than for the higher molecular weight esters.

Orally administered phthalate esters generally produced enlarging of liver and kidney, and atrophy of testes in laboratory animals. Specific esters produced enlargement of heart and brain, spleenitis, and degeneration of central nervous system tissue.

Subacute doses administered orally to laboratory animals produced some decrease in growth and degeneration of the testes. Chronic studies in animals showed similar effects to those found in acute and subacute studies, but to a much lower degree. The same organs were enlarged, but pathological changes were not usually detected.

A recent study of several phthalic esters produced suggestive but not conclusive evidence that dimethyl and diethyl phthalates have a cancer liability. Only four of the six priority pollutant esters were included in the study. Phthalate esters do biconcentrate in fish. The factors, weighted for relative consumption of various aquatic and marine food groups, are used to calculate ambient water quality criteria for four phthalate esters. The values are included in the discussion of the specific esters.

Studies of toxicity of phthalate esters in freshwater and salt water organisms are scarce. Available data show that adverse effects on aquatic life occur at phthalate ester concentrations as low as 0.003 mg/l.

The behavior of phthalate esters in POTW has not been studied. However, the biochemical oxidation of many of the organic priority pollutants has been investigated in laboratory-scale studies at concentrations higher than would normally be expected in municipal wastewater. Three of the phthalate esters were studied. Bis(2-ethylhexyl) phthalate was found to be degraded slightly or not at all and its removal by biological treatment in a POTW is expected to be slight or zero. Di-n-butyl phthalate and diethyl phthalate were degraded to a moderate degree and it is expected that they will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Based on these data and other observations relating molecular structure to ease of biochemical degradation of other organic pollutants, it is expected that butyl benzyl phthalate and dimethyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. On the same basis, it is expected that di-n-octyl phthalate will not be biochemically oxidized to a significant extent by biological treatment in POTW. An EPA study of seven POTW revealed that for all but di-n-octyl phthalate, which was not studied, removals ranged from 62 to 87 percent.

No information was found on possible interference with POTW operation or the possible effects on sludge by the phthalate esters. The water insoluble phthalate esters - butylbenzyl and di-n-octyl phthalate - would tend to remain in sludge, whereas the other four toxic pollutant phthalate esters with water solubilities ranging from 50 mg/l to 4.5 mg/l would probably pass through into the POTW effluent.

Bis (2-ethylhexyl) phthalate(66). In addition to the general remarks and discussion on phthalate esters, specific information on bis(2-ethylhexyl) phthalate is provided. Little information is available about the physical properties of bis(2-ethylhexyl) phthalate. It is a liquid boiling at 387°C at 5mm Hg and is insoluble in water. Its formula is $C_6H_4(COOC_8H_{17})_2$. This priority pollutant constitutes about one third of the phthalate ester production in the U.S. It is commonly referred to as dioctyl phthalate, or DOP, in the plastics industry where it is the most extensively used compound for the plasticization of polyvinyl chloride (PVC). Bis(2-ethylhexyl) phthalate has been approved by the FDA for use in plastics in contact with food. Therefore, it may be found in wastewaters coming in contact with discarded plastic food wrappers as well as the PVC films and shapes normally found in industrial plants. This priority pollutant is also a commonly used organic diffusion pump oil where its low vapor pressure is an advantage.

For the protection of human health from the toxic properties of bis(2-ethylhexyl) phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 15 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criteria is determined to be 50 mg/l.

Although the behavior of bis(2-ethylhexyl) phthalate in POTW has not been studied, biochemical oxidation of this priority pollutant has been studied on a laboratory scale at concentrations higher than would normally be expected in municipal wastewater. In fresh water with a nonacclimated seed culture no biochemical oxidation was observed after 5, 10, and 20 days. However, with an acclimated seed culture, biological oxidation occurred to the extents of 13, 0, 6, and 23 of theoretical after 5, 10, 15 and 20 days, respectively. Bis(2-ethylhexyl) phthalate concentrations were 3 to 10 mg/l. Little or no removal of bis(2-ethylhexyl) phthalate by biological treatment in POTW is expected.

Butyl benzyl phthalate(67). In addition to the general remarks and discussion on phthalate esters, specific information on butyl benzyl phthalate is provided. No information was found on the physical properties of this compound.

Butyl benzyl phthalate is used as a plasticizer for PVC. Two special applications differentiate it from other phthalate esters. It is approved by the U.S. FDA for food contact in wrappers and containers; and it is the industry standard for plasticization of vinyl flooring because it provides stain resistance.

No ambient water criterion is proposed for butyl benzyl phthalate.

Butyl benzyl phthalate removal in POTWs is discussed in the general discussion of phthalate esters.

Di-n-butyl phthalate (68). In addition to the general remarks and discussion on phthalate esters, specific information on di-n-butyl phthalate (DBP) is provided. DBP is a colorless, oily liquid, boiling at 340°C. Its water solubility at room temperature is reported to be 0.4 g/l and 4.5g/l in two different chemistry handbooks. The formula for DBP, $C_6H_4(COOC_4H_9)_2$ is the same as for its isomer, di-isobutyl phthalate. DCP production is one to two percent of total U.S. phthalate ester production.

Dibutyl phthalate is used to a limited extent as a plasticizer for polyvinylchloride (PVC). It is not approved for contact with food. It is used in liquid lipsticks and as a diluent for polysulfide dental impression materials. DBP is used as a plasticizer for nitrocellulose in making gun powder, and as a fuel in solid propellants for rockets.

Further uses are insecticides, safety glass manufacture, textile lubricating agents, printing inks, adhesives, paper coatings and resin solvents.

For protection of human health from the toxic properties of dibutyl phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 34 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 154 mg/l.

Although the behavior of di-n-butyl phthalate in POTW has not been studied, biochemical oxidation of this toxic pollutant has been studied on a laboratory scale at concentrations higher than would normally be expected in municipal wastewater. Biochemical oxidation of 35, 43, and 45 percent of theoretical oxidation were obtained after 5, 10, and 20 days, respectively, using sewage microorganisms as an unacclimated seed culture. Based on these data, it is expected that di-n-butyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

Biological treatment in POTW is expected to remove di-n-butyl phthalate to a moderate degree.

Di-n-octyl phthalate(69). In addition to the general remarks and discussion on phthalate esters, specific information on di-n-octyl phthalate is provided. Di-n-octyl phthalate is not to be confused with the isomeric bis(2-ethylhexyl) phthalate which is commonly referred to in the plastics industry as DOP. Di-n-octyl phthalate is a liquid which boils at 220°C at 5 mm Hg. It is insoluble in water. Its molecular formula is $C_6H_4(COOC_8H_{17})_2$. Its production constitutes about one percent of all phthalate ester production in the U.S.

Industrially, di-n-octyl phthalate is used to plasticize polyvinyl chloride (PVC) resins.

No ambient water criterion is proposed for di-n-octyl phthalate.

Biological treatment in POTW is expected to lead to little or no removal of di-n-octyl phthalate.

Diethyl phthalate (70). In addition to the general remarks and discussion on phthalate esters, specific information on diethyl phthalate is provided. Diethyl phthalate, or DEP, is a colorless liquid boiling at 296°C, and is insoluble in water. Its molecular formula is $C_6H_4(COOC_2H_5)_2$. Production of diethyl phthalate constitutes about 1.5 percent of phthalate ester production in the U.S.

Diethyl phthalate is approved for use in plastic food containers by the U.S. FDA. In addition to its use as a polyvinylchloride (PVC) plasticizer, DEP is used to plasticize cellulose nitrate for gun powder, to dilute polysulfide dental impression materials, and as an accelerator for dying triacetate fibers. An additional use which would contribute to its wide distribution in the environment is as an approved special denaturant for ethyl alcohol. The alcohol-containing products for which DEP is an approved denaturant include a wide range of personal care items such as bath preparations, bay rum, colognes, hair preparations, face and hand creams, perfumes and toilet soaps. Additionally, this denaturant is approved for use in biocides, cleaning solutions, disinfectants, insecticides, fungicides, and room deodorants which have ethyl alcohol as part of the formulation. It is expected, therefore, that people and buildings would have some surface loading of this priority pollutant which would find its way into raw wastewaters.

For the protection of human health from the toxic properties of diethyl phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 350 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 1800 mg/l.

Although the behavior of diethylphthalate in POTW has not been studied, biochemical oxidation of this toxic pollutant has been studied on a laboratory scale at concentrations higher than would normally be expected in municipal wastewater. Biochemical oxidation of 79, 84, and 89 percent of theoretical was observed after 5, 5, and 20 days, respectively. Based on these data it is expected that diethyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

Dimethyl phthalate (71). In addition to the general remarks and discussion on phthalate esters, specific information on dimethyl phthalate (DMP) is provided. DMP has the lowest molecular weight of the phthalate esters - M.W. = 194 compared to M.W. of 391 for bis(2-ethylhexyl)phthalate. DMP has a boiling point of 282°C. It is a colorless liquid, soluble in water to the extent of 5 mg/l. Its molecular formula is $C_6H_4(COOCH_3)_2$.

Dimethyl phthalate production in the U.S. is just under one percent of total phthalate ester production. DMP is used to some extent as a plasticizer in cellulosics. However, its principle specific use is for dispersion of polyvinylidene fluoride (PVDF). PVDF is resistant to most chemicals and finds use as electrical insulation, chemical process equipment (particularly pipe), and as a base for long-life finishes for exterior metal siding. Coil coating techniques are used to apply PVDF dispersions to aluminum or galvanized steel siding.

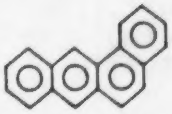
For the protection of human health from the toxic properties of dimethyl phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 313 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 2800 mg/l.

Based on limited data and observations relating molecular structure to ease of biochemical degradation of other organic pollutants, it is expected that dimethyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage of biological treatment in POTWs.

Polynuclear Aromatic Hydrocarbons(72-84). The polynuclear aromatic hydrocarbons (PAH) selected as toxic pollutants are a group of 13 compounds consisting of substituted and unsubstituted polycyclic aromatic rings. The general class of PAH includes hetrocyclics, but none of those were selected as toxic pollutants. PAH are formed as the result of incomplete combustion when organic compounds are burned with insufficient oxygen. PAH are found in coke oven emissions, vehicular emissions, and volatile products of oil and gas burning. The compounds chosen as priority pollutants are listed with the structural formula and melting point (m.p.) for each. All are insoluble in water.

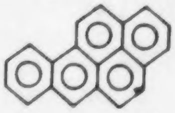
72 Benzo(a)anthrancene (1,2-benzanthracene)

m.p. 162°C



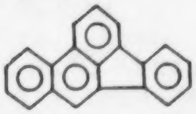
73 Benzo(a)pyrene (3,4-benzopyrene)

m.p. 176°C



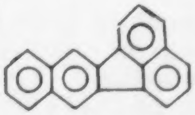
74 3,4-Benzofluoranthene

m.p. 168°C



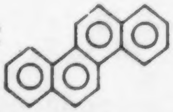
75 Benzo(k)fluoranthene (11,12-benzofluoranthene)

m.p. 217°C



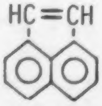
76 Chrysene (1,2-benzphenanthrene)

m.p. 255°C



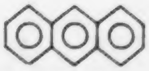
77 Acenaphthylene
HC=CH

m.p. 92°C



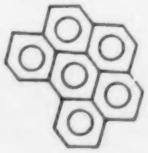
78 Anthracene

m.p. 216°C



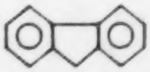
79 Benzo(ghi)perylene (1,12-benzoperylene)

m.p. not reported



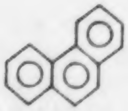
80 Fluorene (alpha-diphenylenemethane)

m.p. 116°C



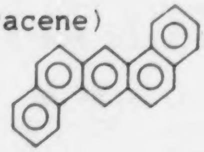
81 Phenanthrene

m.p. 101°C



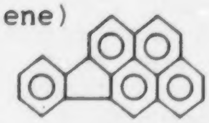
82 Dibenzo(a,h)anthracene (1,2,5,6-dibenzoanthracene)

m.p. 269°C



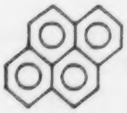
83 Indeno(1,2,3-cd)pyrene (2,3-o-phenyleneperylene)

m.p. not available



84 Pyrene

m.p. 156°C



Some of these priority pollutants have commercial or industrial uses. Benzo(a)anthracene, benzo(a)pyrene, chrysene, anthracene, dibenzo(a,h)anthracene, and pyrene are all used as antioxidants. Chrysene, acenaphthylene, anthracene, fluorene, phenanthrene, and pyrene are all used for synthesis of dyestuffs or other organic chemicals. 3,4-Benzofluoranthrene, benzo(k)fluoranthene, benzo(ghi)perylene, and indeno (1,2,3-cd)pyrene have no known industrial uses, according to the results of a recent literature search.

Several of the PAH toxic pollutants are found in smoked meats, in smoke flavoring mixtures, in vegetable oils, and in coffee. They are found in soils and sediments in river beds. Consequently, they are also found in many drinking water supplies. The wide distribution of these pollutants in complex mixtures with the many other PAHs which have not been designated as toxic pollutants results in exposures by humans that cannot be associated with specific individual compounds.

The screening and verification analysis procedures used for the organic toxic pollutants are based on gas chromatography (GC). Three pairs of the PAH have identical elution times on the column specified in the protocol, which means that the pollutants of the pair are not differentiated. For these three pairs [anthracene (78) - phenanthrene (81); 3,4-benzofluoranthene (74) - benzo(k)fluoranthene (75); and benzo(a)anthracene (72) - chrysene (76)] results are obtained and reported as "either-or." Either both are present in the combined concentration reported, or one is present in the concentration reported. When detections below reportable limits are recorded no further analysis is required. For samples where the concentrations of coeluting pairs have a significant value, additional analyses are conducted, using different procedures that resolve the particular pair.

There are no studies to document the possible carcinogenic risks to humans by direct ingestion. Air pollution studies indicate an excess of lung cancer mortality among workers exposed to large amounts of PAH containing materials such as coal gas, tars, and coke-oven emissions. However, no definite proof exists that the PAH present in these materials are responsible for the cancers observed.

Animal studies have demonstrated the toxicity of PAH by oral and dermal administration. The carcinogenicity of PAH has been traced to formation of PAH metabolites which, in turn, lead to tumor formation. Because the levels of PAH which induce cancer are very low, little work has been done on other health hazards resulting from exposure. It has been established in animal studies that tissue damage and systemic toxicity can result from exposure to noncarcinogenic PAH compounds.

Because there were no studies available regarding chronic oral exposures to PAH mixtures, proposed water quality criteria were derived using data on exposure to a single compound. Two studies were selected, one involving benzo(a)pyrene ingestion and one involving dibenzo(a,h)anthracene ingestion. Both are known animal carcinogens.

For the maximum protection of human health from the potential carcinogenic effects of exposure to polynuclear aromatic hydro- carbons (PAH) through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of PAH estimated to result in additional lifetime cancer risk of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are 2.8 x $10^{-7}$ mg/l, 2.8 x $a0^{-6}$ mg/l and 2.8 x $10^{-5}$ mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 3.11 x $10^{-4}$ mg/l to keep the increased lifetime cancer risk below $10^{-5}$. Available data show the adverse effects on aquatic life occur at concentrations higher than those cited for human health risk.

The behavior of PAH in POTW has received only a limited amount of study. It is reported that up to 90 percent of PAH entering a POTW will be retained in the sludge generated by conventional sewage treatment processes. Some of the PAH can inhibit bacterial growth when they are present at concentrations as low as 0.018 mg/l. Biological treatment in activated sludge units has been shown to reduce the concentration of phenanthrene and anthracene to some extent. However, a study of biochemcial oxidation of fluorene on a laboratory scale showed no degradation after 5, 10, and 20 days. On the basis of that study and studies of other organic priority pollutants, some general observations were made relating molecular structure to ease of degradation. Those observations lead to the conclusion that the 13 PAH selected to represent that group as toxic pollutants will be removed only slightly or not at all by biological treatment methods in POTW. Based on their water insolubility and tendency to attach to sediment particles very little pass through of PAH to POTW effluent is expected.

No data are available at this time to support any conclusions about contamination of land by PAH on which sewage sludge containing PAH is spread.

Tetrachloroethylene(85). Tetrachloroethylene ($CCl_2CCl_2$), also called perchloroethylene and PCE, is a colorless nonflammable liquid produced mainly by two methods - chlorination and pyrolysis of ethane and propane, and oxychlorination of dichloroethane. U.S. annual production exceeds 300,000 tons. PCE boils at 121°C and has a vapor pressure of 19 mm Hg at 20°C. It is insoluble in water but soluble in organic solvents.

Approximately two-thirds of the U.S. production of PCE is used for dry cleaning. Textile processing and metal degreasing, in equal amounts consume about one-quarter of the U.S. production.

The principal toxic effect of PCE on humans is central nervous system depression when the compound is inhaled. Headache, fatigue, sleepiness, dizziness and sensations of intoxication are reported. Severity of effects increases with vapor concentration. High integrated exposure (concentration times duration) produces kidney and liver damage. Very limited data on PCE ingested by laboratory animals indicate liver damage occurs when PCE is administered by that route. PCE tends to distribute to fat in mammalian bodies.

One report found in the literature suggests, but does not conclude, that PCE is teratogenic. PCE has been demonstrated to be a liver carcinogen in B6C3-F1 mice.

For the maximum protection of human health from the potential carcinogenic effects of exposure to tetrachloroethylene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of tetrachloroethylene estimated to result in additional lifetime cancer risk levels of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are $8 \times 10^{-5}$ mg/l, $8 \times 10^{-4}$ mg/l, and $8 \times 10^{-3}$ mg/l respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 0.088 mg/l to keep the increased lifetime cancer risk below $10^{-5}$. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Few data were found regarding the behavior of PCE in POTW. Many of the organic toxic pollutants have been investigated, at least in laboratory scale studies, at concentrations higher than those expected to be contained by most municipal wastewaters. General observations have been developed relating molecular structure to ease of degradation for all of the organic toxic pollutants. Based on study of the limited data, it is expected that PCE will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. An EPA study of seven POTW revealed removals of 40 to 100 percent. Sludge concentrations of tetrachloroethylene ranged from $1 \times 10^{-3}$ to 1.6 mg/l. Some PCE is expected to be volatilized in aerobic treatment processes and little, if any, is expected to pass through into the effluent from the POTW.

Toluene(86). Toluene is a clear, colorless liquid with a benzene like odor. It is a naturally occuring compound derived primarily from petroleum or petrochemical processes. Some toluene is obtained from the manufacture of metallurgical coke. Toluene is also referred to as totuol, methylbenzene, methacide, and phenymethane. It is an aromatic hydrocarbon with the formula $C_6H_5CH_3$. It boils at 111°C and has a vapor pressure of 30 mm Hg at room temperature. The water solubility of toluene is 535 mg/l, and it is miscible with a variety of organic solvents. Annual production of toluene in the U.S. is greater than 2 million metric tons. Approximately two-thirds of the toluene is converted to benzene and the remaining 30 percent is divided approximately equally into chemical manufacture, and use as a paint solvent and aviation gasoline additive. An estimated 5,000 metric tons is discharged to the environment annually as a constituent in wastewater.

Most data on the effects of toluene in human and other mammals have been based on inhalation exposure or dermal contact studies. There appear to be no reports of oral administration of toluene to human subjects. A long term toxicity study on female rats revealed no adverse effects on growth, mortality, appearance and behavior, organ to body weight ratios, blood-urea nitrogen levels, bone marrow counts, peripheral blood counts, or morphology of major organs. The effects of inhaled toluene on the central nervous system, both at high and low concentrations, have been studied in humans and animals. However, ingested toluene is expected to be handled differently by the body because it is absorbed more slowly and must first pass through the liver before reaching the nervous system. Toluene is extensively and rapidly metabolized in the liver. One of the principal metabolic products of toluene is benzoic acid, which itself seems to have little potential to produce tissue injury.

Toluene does not appear to be teratogenic in laboratory animals or man. Nor is there any conclusive evidence that toluene is mutagenic. Toluene has not been demonstrated to be positive in any *in vitro* mutagenicity or carcinogenicity bioassay system, nor to be carcinogenic in animals or man.

Toluene has been found in fish caught in harbor waters in the vicinity of petroleum and petrochemical plants. Bioconcentration studies have not been conducted, but bioconcentration factors have been calculated on the basis of the octanol-water partition coefficient.

For the protection of human health from the toxic properties of toluene ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 14.3 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water quality criterion is 424 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 5 mg/l.

Acute toxicity tests have been conducted with toluene and a variety of freshwater fish and Daphnia magna. The latter appears to be significantly more resistant than fish. No test results have been reported for the chronic effects of toluene on freshwater fish or invertebrate species.

Only one study of toluene behavior in POTW is available. However, the biochemical oxidation of many of the toxic pollutants has been investigated in laboratory scale studies at con- centrations greater than those expected to be contained by most municipal wastewaters. At toluene concentrations ranging from 3 to 250 mg/l biochemical oxidation proceeded to fifty percent of theroetical or greater. The time period varied from a few hours to 20 days depending on whether or not the seed culture was acclimated. Phenol adapted acclimated seed cultures gave the most rapid and extensive biochemical oxidation. Based on study of the limited data, it is expected that toluene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. The volatility and relatively low water solubility of toluene lead to the expectation that aeration processes will remove significant quantities of toluene from the POTW. The EPA studied toluene removal in seven POTW. The removals ranged from 40 to 100 percent. Sludge concentrations of toluene ranged from $54 \times 10^{-3}$ to 1.85 mg/l.

Antimony(114). Antimony (chemical name - stibium, symbol Sb) classified as a nonmetal or metalloid, is a silvery white , brittle, crystalline solid. Antimony is found in small ore bodies throughout the world. Principal ores are oxides of mixed antimony valences, and an oxysulfide ore. Complex ores with metals are important because the antimony is recovered as a by-product. Antimony melts at 631°C, and is a poor conductor of electricity and heat.

Annual U.S. consumption of primary antimony ranges from 10,000 to 20,000 tons. About half is consumed in metal products - mostly antimonial lead for lead acid storage batteries, and about half in non - metal products. A principal compound is antimony trioxide which is used as a flame retardant in fabrics, and as an opacifier in glass, ceramincs, and enamels. Several antimony compounds are used as catalysts in organic chemicals synthesis, as fluorinating agents (the antimony fluoride), as pigments, and in fireworks. Semiconductor applications are economically significant.

Essentially no information on antimony - induced human health effects has been derived from community epidemiolocy studies. The available data are in literature relating effects observed with therapeutic or medicinal uses of antimony compounds and industrial exposure studies. Large therapeutic doses of antimonial compounds, usually used to treat schistisomiasis, have caused severe nausea, vomiting, convulsions, irregular heart action, liver damage, and skin rashes. Studies of acute industrial antimony poisoning have revealed loss of appetite, diarrhea, headache, and dizziness in addition to the symptoms found in studies of therapeutic doses of antimony.

For the protection of human health from the toxic properties of antimony ingested through water and through contaminated aquatic organisms the ambient water criterion is determined to be 0.146 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is determined to be 45 mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Very little information is available regarding the behavior of antimony in POTW. The limited solubility of most antimony compounds expected in POTW, i.e. the oxides and sulfides, suggests that at least part of the antimony entering a POTW will be precipitated and incorporated into the sludge. However, some antimony is expected to remain dissolved and pass through the POTW into the effluent. Antimony compounds remaining in the sludge under anaerobic conditions may be connected to stibine ($SbH_3$), a very soluble and very toxic compound. There are no data to show antimony inhibits any POTW processes. Antimony is not known to be essential to the growth of plants, and has been reported to be moderately toxic. Therefore, sludge containing large amounts of antimony could be detrimental to plants if it is applied in large amounts to cropland.

Arsenic(115). Arsenic (chemical symbol As), is classified as a nonmetal or metalloid. Elemental arsenic normally exists in the alpha-crystalline metallic form which is steel gray and brittle, and in the beta form which is dark gray and amorphous. Arsenic sublimes at 615°C. Arsenic is widely distributed throughout the world in a large number of minerals. The most important commercial source of arsenic is as a by-product from treatment of copper, lead, cobalt, and gold ores. Arsenic is usually marketed as the trioxide ($As_2O_3$). Annual U.S. production of the trioxide approaches 40,000 tons.

The principal use of arsenic is in agricultural chemicals (herbicides) for controlling weeds in cotton fields. Arsenicals have various applications in medicinal and veterinary use, as wood preservatives, and in semiconductors.

The effects of arsenic in humans were known by the ancient Greeks and Romans. The principal toxic effects are gastrointestinal disturbances. Breakdown of red blood cells occurs. Symptoms of acute poisoning include vomiting, diarrhea, abdominal pain, lassitude, dizziness, and headache. Longer exposure produced dry, falling hair, brittle, loose nails, eczema; and exfoliation. Arsenicals also exhibit teratogenic and mutagenic effects in humans. Oral administration of arsenic compounds has been associated clinically with skin cancer for nearly a hundred years. Since 1888 numerous studies have linked occupational exposure to, and therapeutic administration of arsenic compounds to increased incidence of respiratory and skin cancer.

For the maximum protection of human health from the potential carcinogenic effects of exposure to arsenic through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of arsenic estimated to result in additional lifetime cancer risk levels of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are $2.2 \times 10^{-7}$ mg/l, $2.2 \times 10^{-6}$ mg/l, and $2.2 \times 10^{-5}$ mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than $2.7 \times 10^{-4}$ mg/l to keep the increased lifetime cancer risk below $10^{-5}$. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

A few studies have been made regarding the behavior of arsenic in POTW. One EPA survey of 9 POTW reported influent concentrations ranging from 0.0005 to 0.693 mg/l; effluents from 3 POTW having biological treatment contained 0.0004 - 0.01 mg/l; 2 POTW showed arsenic removal efficiencies of 50 and 71 percent in biological treatment. Inhibition of treatment processes by sodium arsenate is reported to occur at 0.1 mg/l in activated sludge, and 1.6 mg/l in anaerobic digestion processes. In another study based on data from 60 POTW, arsenic in sludge ranged from 1.6 to 65.6 mg/kg and the median value was 7.8 mg/kg. Arsenic in sludge spread on cropland may be taken up by plants grown on that land. Edible palnts can take up arsenic, but normally their growth is inhibited before the palnts are ready for harvest.

Cadmium(118). Cadmium is a relatively rare metallic element that is seldom found in sufficient quantities in a pure state to warrant mining or extraction from the earth's surface. It is found in trace amounts of about 1 ppm throughout the earth's crust. Cadmium is, however, a valuable by-product of zinc production.

Cadmium is used primarily as an electroplated metal, and is found as an impurity in the secondary refining of zinc, lead, and copper.

Cadmium is an extremely dangerous cumulative toxicant, causing progressive chronic poisoning in mammals, fish, and probably other organisms. The metal is not excreted.

Toxic effects of cadmium on man have been reported from throughout the world. Cadmium may be a factor in the development of such human pathological conditions as kidney disease, testicular tumors, hypertension, arteriosclerosis, growth inhibition, chronic disease of old age, and cancer. Cadmium is normally ingested by humans through food and water as well as by breathing air contaminated by cadmium dust. Cadmium is cumulative in the liver, kidney, pancreas, and thyroid of humans and other animals. A severe bone and kidney syndrome known as itai-itai disease has been documented in Japan as caused by cadmium ingestion via drinking water and contaminated irrigation water. Ingestion of as little as 0.6 mg/day has produced the disease. Cadmium acts synergistically with other metals. Copper and zinc substantially increase its toxicity.

Cadmium is concentrated by marine organisms, particularly mollusks, which accumulate cadmium in calcareous tissues and in the viscera. A concentration factor of 1000 for cadmium in fish muscle has been reported, as have concentration factors of 3000 in marine plants and up to 29,600 in certain marine animals. The eggs and larvae of fish are apparently more sensitive than adult fish to poisoning by cadmium, and crustaceans appear to be more sensitive than fish eggs and larvae.

For the protection of human health from the toxic properties of cadmium ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 0.010 mg/l. Available data show that adverse effects on aquatic life occur at concentrations in the same range as those cited for human health, and they are highly dependent on water hardness.

Cadmium is not destroyed when it is introduced into a POTW, and will either pass through to the POTW effluent or be incorporated into the POTW sludge. In addition, it can interfere with the POTW treatment process.

In a study of 189 POTW, 75 percent of the primary plants, 57 percent of the trickling filter plants, 66 percent of the activated sludge plants and 62 percent of the biological plants allowed over 90 percent of the influent cadmium to pass thorugh to the POTW effluent. Only 2 of the 189 POTW allowed less than 20 percent pass-through, and none less than 10 percent pass-through. POTW effluent concentrations ranged from 0.001 to 1.97 mg/l (mean 0.028 mg/l, standard deviation 0.167 mg/l).

Cadmium not passed through the POTW will be retained in the sludge where it is likely to build up in concentration. Cadmium contamination of sewage sludge limits its use on land since it increases the level of cadmium in the soil. Data show that cadmium can be incorporated into crops, including vegetables and grains, from contaminated soils. Since the crops themselves show no adverse effects from soils with levels up to 100 mg/kg cadmium, these contaminated crops could have a significant impact on human health. Two Federal agencies have already recognized the potential adverse human health effects posed by the use of sludge on cropland. The FDA recommends that sludge containing over 30 mg/kg of cadmium should not be used on agricultural land. Sewage sludge contains 3 to 300 mg/kg (dry basis) of cadmium mean = 10 mg/kg; median = 16 mg/kg. The USDA also recommends placing limits on the total cadmium from sludge that may be applied to land.

Chromium(119). Chromium is an elemental metal usually found as a chromite ($FeO \bullet Cr_2O_3$). The metal is normally produced by reducing the oxide with aluminum. A significant proportion of the chromium used is in the form of compounds such as sodium dichromate ($Na_2CrO_4$), and chromic acid ($CrO_3$) - both are hexavalent chromium compounds.

Chromium is found as an alloying component of many steels and its compounds are used in electroplating baths, and as corrosion inhibitors for closed water circulation systems.

The two chromium forms most frequently found in industry wastewaters are hexavalent and trivalent chromium. Hexavalaent chromium is the form used for metal treatments. Some of it is reduced to trivalent chromium as part of the process reaction. The raw wastewater containing both valence states is usually treated first to reduce remaining hexavalent to trivalent chromium, and second to precipitate the trivalent form as the hydroxide. The hexavalent form is not removed by lime treatment.

Chromium, in its various valence states, is hazardous to man. It can produce lung tumors when inhaled, and induces skin sensitizations. Large doses of chromates have corrosive effects on the intestinal tract and can cause inflammation of the kidneys. Hexavalent chromium is a known human carcinogen. Levels of chromate ions that show no effect in man appear to be so low as to prohibit determination, to date.

The toxicity of chromium salts to fish and other aquatic life varies widely with the species, temperature, pH, valence of the chromium, and synergistic or antagonistic effects, especially the effect of water hardness. Studies have shown that trivalent chromium is more toxic to fish of some types than is hexavalent chromium. Hexavalent chromium retards growth of one fish species at 0.0002 mg/l. Fish food organisms and other lower forms of aquatic life are extremely sensitive to chromium. Therefore, both hexavalent and trivalent chromium must be considered harmful to particular fish or organisms.

For the protection of human health from the toxic properties of chromium (except hexavalent chromium) ingested through water and contaminated aquatic organisms, the ambient water criterion is 0.050 mg/l. For the maximum protection of human health from the potential carcinogenic effects of exposure to hexavalent chromium through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. The estimated levels which would result in increased lifetime cancer risks of $10^{-7}$, $10^{-6}$, and $10^{-5}$ are 7.4 x $10^{-8}$ mg/l, 7.4 x $10^{-7}$ mg/l, and 7.4 x $10^{-6}$ mg/l respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 1.5 x $10^{-5}$ mg/l to keet the increased lifetime cancer risk below $10^{-5}$.

Chromium is not destroyed when treated by POTW (although the oxidation state may change), and will either pass through to the POTW effluent or be incorporated into the POTW sludge. Both oxidation states can cause POTW treatment inhibition and can also limit the usefuleness of municipal sludge.

Influent concentrations of chromium to POTW facilities have been observed by EPA to range from 0.005 to 14.0 mg/l, with a median concentration of 0.1 mg/l. The efficiencies for removal of chromium by the activated sludge process can vary greatly, depending on chromium concentration in the influent, and other operating conditions at the POTW. Chelation of chromium by organic matter and dissolution due to the presence of carbonates can cause deviations from the predicted behavior in treatment systems.

The systematic presence of chromium compounds will halt nitrification in a POTW for short periods, and most of the chromium will be retained in the sludge solids. Hexavalent chromium has been reported to severely affect the nitrification process, but trivalent chromium has litte or no toxicity to activated sludge, except at high concentrations. The presence of iron, copper, and low pH will increase the toxicity of chromium in a POTW by releasing the chromium into solution to be ingested by microorganisms in the POTW.

The amount of chromium which passes through to the POTW effluent depends on the type of treatment processes used by the POTW. In a study of 240 POTWs 56 percent of the primary plants allowed more than 80 percent pass through to POTW effluent. More advanced treatment results in less pass-through. POTW effluent concentrations ranged from 0.003 to 3.2 mg/l total chromium (mean = 0.197, standard deviation = 0.48), and from 0.002 to 0.1 mg/l hexavalent chromium (mean = 0.017, standard deviation = 0.020).

Chromium not passed through the POTW will be retained in the sludge, where it is likely to build up in concentration. Sludge concentrations of total chromium of over 20,000 mg/kg (dry basis) have been observed. Disposal of sludges containing very high concentrations of trivalent chromium can potentially cause problems in uncontrollable landfills. Incineration, or similar destructive oxidation processes can produce hexavalent chromium from lower valance states. Hexavalent chromium is potentially more toxic than trivalent chromium. In cases where high rates of chrome sludge application on land are used, distinct growth inhibition and plant tissue uptake have been noted.

Pretreatment of discharges substantially reduces the concentration of chromium in sludge. In Buffalo, New York, pretreatment of electroplating waste resulted in a decrease in chromium concentrations in POTW sludge from 2,510 to 1,040 mg/kg. A similar reduction occurred in in Grand Rapids, Michigan POTW where the chromium concentration in sludge decreased from 11,000 to 2,700 mg/kg when pretreatment was made a requirement.

Copper(120). Copper is a metallic element that sometimes is found free, as the native metal, and is also found in minerals such as cuprite ($Cu_2O$), malechite $[CuCO_3 \bullet Cu(OH)_2]$, azurite $[2CuCO_3 \bullet Cu(OH)_2]$, chalcopyrite ($CuFeS_2$), and bornite ($Cu_5FeS_4$). Copper is obtained from these ores by smelting, leaching, and electrolysis. It is used in the plating, electrical, plumbing, and heating equipment industries, as well as in insecticides and fungicides.

Traces of copper are found in all forms of plant and animal life, and the metal is an essential trace element for nutrition. Copper is not considered to be a cumulative systemic poison for humans as it is readily excreted by the body, but it can cause symptoms of gastroenteritis, with nausea and intestinal irritations, at relatively low dosages. The limiting factor in domestic water supplies is taste. To prevent this adverse organoleptic effect of copper in water, a criterion of 1 mg/l has been established.

The toxicity of copper to aquatic organisms varies significantly, not only with the species, but also with the physical and chemical characteristics of the water, including temperature, hardness, turbidity, and carbon dioxide content. In hard water, the toxicity of copper salts may be reduced by the precipitation of copper carbonate or other insoluble compounds. The sulfates of copper and zinc, and of copper and calcium are synergistic in their toxic effect on fish.

Relatively high concentrations of copper may be tolerated by adult fish for short periods of time; the critical effect of copper appears to be its higher toxicity to young or juvenile fish. Concentrations of 0.02 to 0.031 mg/l have proven fatal to some common fish species. In general the salmonoids are very sensitive and the sunfishes are less sensitive to copper.

The recommended criterion to protect saltwater aquatic life is 0.00097 mg/l as a 24-hour average, and 0.018 mg/l maximum concentration.

Copper salts cause undesirable color reactions in the food industry and cause pitting when deposited on some other metals such as aluminum and galvanized steel. To control undesirable taste and odor quality of ambient water due to the organoleptic properties of copper, the estimated level is 1.0 mg/l. For total recoverable copper the criterion to protect freshwater aquatic life is 5.6 x $10^{-3}$ mg/l as a 24 hour average.

Irrigation water containing more than minute quantities of copper can be detrimental to certain crops. Copper appears in all soils, and its concentration ranges from 10 to 80 ppm. In soils, copper occurs in association with hydrous oxides of manganese and iron, and also as soluble and insoluble complexes with organic matter. Copper is essential to the life of plants, and the normal range of concentration in plant tissue is from 5 to 20 ppm. Copper concentrations in plants normally do not build up to high levels when toxicity occurs. For example, the concentrations of copper in snapbean leaves and pods was less than 50 and 20 mg/kg, respectively, under conditions of severe copper toxicity. Even under conditions of copper toxicity, most of the excess copper accumulates in the roots; very little is moved to the aerial part of the plant.

Copper is not destroyed when treated by a POTW, and will either pass through to the POTW effluent or be retained in the POTW sludge. It can interfere with the POTW treatment processes and can limit the usefulness of municipal sludge.

The influent concentration of copper to POTW facilities has been observed by the EPA to range from 0.01 to 1.97 mg/l, with a median concentration of 0.12 mg/l. The copper that is removed from the influent stream of a POTW is adsorbed on the sludge or appears in the sludge as the hydroxide of the metal. Bench scale pilot studies have shown that from about 25 percent to 75 percent of the copper passing through the activated sludge process remains in solution in the final effluent. Four-hour slug dosages of copper sulfate in concentrations exceeding 50 mg/l were reported to have severe effects on the removal efficiency of an unacclimated system, with the system returning to normal in about 100 hours. Slug dosages of copper in the form of copper cyanide were observed to have much more severe effects on the activated sludge system, but the total system returned to normal in 24 hours.

In a recent study of 268 POTW, the median pass-through was over 80 percent for primary plants and 40 to 50 percent for trickling filter, activated sludge, and biological treatment plants. POTW effluent concentrations of copper ranged from 0.003 to 1.8 mg/l (mean 0.126, standard deviation 0.242).

Copper which does not pass through the POTW will be retained in the sludge where it will build up in concentration. The presence of excessive levels of copper in sludge may limit its use on cropland. Sewage sludge contains up to 16,000 mg/kg of copper, with 730 mg/kg as the mean value. These concentrations are significantly greater than those normally found in soil, which usually range from 18 to 80 mg/kg. Experimental data indicate that when dried sludge is spread over tillable land, the copper tends to remain in place down to the depth of tillage, except for copper which is taken up by plants grown in the soil. Recent investigation has shown that the extractable copper content of sludge-treated soil decreased with time, which suggests a reversion of copper to less soluble forms was occurring.

Cyanide(121). Cyanides are among the most toxic of pollutants commonly observed in industrial wastewaters. Introduction of cyanide into industrial processes is usually by dissolution of potassium cyanide (KCN) or sodium cyanide (NaCN) in process waters. However, hydrogen cyanide (HCN) formed when the above salts are dissolved in water, is probably the most acutely lethal compound.

The relationship of pH to hydrogen cyanide formation is very important. As pH is lowered to below 7, more than 99 percent of the cyanide is present as HCN and less than 1 percent as cyanide ions. Thus, at neutral pH, that of most living organisms, the more toxic form of cyanide prevails.

Cyanide ions combine with numerous heavy metal ions to form complexes. The complexes are in equilibrium with HCN. Thus, the stability of the metal-cyanide complex and the pH determine the concentration of HCN. Stability of the metal-cyanide anion complexes is extremely variable. Those formed with zinc, copper, and cadmium are not stable - they rapidly dissociate, with production of HCN, in near neutral or acid waters. Some of the complexes are extremely stable. Cobaltocyanide is very resistant to acid distillation in the laboratory. Iron cyanide complexes are also stable, but undergo photodecomposition to give HCN upon exposure to sunlight. Synergistic effects have been demonstrated for the metal cyanide complexes making zinc, copper, and cadmiun, cyanides more toxic than an equal concentration of sodium cyanide.

The toxic mechanism of cyanide is essentially an inhibition of oxygen metabolism, i.e., rendering the tissues incapable of exchanging oxygen. The cyanogen compounds are true noncummulative protoplasmic poisons. They arrest the activity of all forms of animal life. Cyanide shows a very specific type of toxic action. It inhibits the cytochrome oxidase system. This system is the one which facilitates electron transfer from reduced metabolites to molecular oxygen. The human body can convert cyanide to a nontoxic thiocyanate and elminiate it. However, if the quantity of cyanide ingested is too great at one time, the inhibition of oxygen utilization proves fatal before the detoxifying reaction reduces the cyanide con- centration to a safe level.

Cyanides are more toxic to fish than to lower forms of aquatic organisms such as midge larvae, crustaceans, and mussels. Toxicity to fish is a function of chemical form and concentration, and is influenced by the rate of metabolism (temperature), the level of dissolved oxygen, and pH. In laboratory studies free cyanide concentrations ranging from 0.05 to 0.15 mg/l have been proven to be fatal to sensitive fish species including trout, bluegill, and fathead minnows. Levels above 0.2 mg/l are rapidly fatal to most fish species. Long term sublethal concentrations of cyanide as low as 0.01 mg/l have been shown to affect the ability of fish to function normally, e.g., reproduce, grow, and swim.

For the protection of human health from the toxic properties of cyanide ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 0.200 mg/l. Available data show taht adverse effects on aquatic life occur at concentrations as low as $3.5 \times 10^{-3}$ mg/l.

Persistance of cyanide in water is highly variable and depends upon the chemical form of cyanide in the water, the concentration of cyanide, and the nature of other constituents. Cyanide may be destroyed by strong oxidizing agents such as permanganate and chlorine. Chlorine is commonly used to oxidize strong cyanide solutions. Carbon dioxide and nitrogen are the products of complete oxidation. But if the reaction is not complete, the very toxic compound, cyanogen chloride, may remain in the treatment system and subsequently be released to the environment. Partial chlorination may occur as part of a POTW treatment, or during the disinfection treatment of surface water for drinking water preparation.

Cyanides can interfere with treatment processes in POTW, or pass through to ambient waters. At low concentrations and with acclimated microflora, cyanide may be decomposed by microorganisms in anaerobic and aerobic environments or waste treatment systems. However, data indicate that much of the cyanide introduced passes through to the POTW effluent. The mean pass-through of 14 biological plants was 71 percent. In a recent study of 41 POTW the effluent concentrations ranged from 0.002 to 100 mg/l (mean = 2.518, standard deviation = 15.6). Cyanide also enhances the toxicity of metals commonly found in POTW effluents, including the toxic pollutants cadmium, zinc, and copper.

Data for Grand Rapids, Michigan, showed a significant decline in cyanide concentrations downstream from the POTW after pretreat- ment regulations were put in force. Concentrations fell from 0.66 mg/l before, to 0.01 mg/l after pretreatment was required.

Lead (122). Lead is a soft, malleable, ductible, blueish-gray, metallic element, usually obtained from the mineral galena (lead sulfide, PbS), anglesite (lead sulfate, $PbSO_4$), or cerussite (lead carbonate, $PbCO_3$). Because it is usually associated with minerals of zinc, silver, copper, gold, cadmium, antimony, and arsenic, special purification methods are frequently used before and after extraction of the metal from the ore concentrate by smelting.

Lead is widely used for its corrosion resistance, sound and vibration absorption, low melting point (solders), and relatively high imperviousness to various forms of radiation. Small amounts of copper, antimony and other metals can be alloyed with lead to achieve greater hardness, stiffness, or corrosion resistance than is afforded by the pure metal. Lead compounds are used in glazes and paints. About one third of U.S. lead consumption goes into storage batteries. About half of U.S. lead consumption is from secondary lead recovery. U.S. consumption of lead is in the range of one million tons annually.

Lead ingested by humans produces a variety of toxic effects including impaired reproductive ability, disturbances in blood chemistry, neurological disorders, kidney damage, and adverse cardiovascular effects. Exposure to lead in the diet results in permanent increase in lead levels in the body. Most of the lead entering the body eventually becomes localized in the bones where it accumulates. Lead is a carcinogen or cocarcinogen in some species of experimental animals. Lead is terratogenic in experimental animals. Mutangenicity data are not available for lead.

For the protection of human health from the toxic properties of lead ingested through water and through contaminated aquatic organisms, the ambient water criterion is 0.050 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as $7.5 \times 10^{-4}$ mg/l.

Lead is not destroyed in POTW, but is passed through to the effluent or retained in the POTW sludge; it can interfere with POTW treatment processes and can limit the usefulness of POTW sludge for application to agricultural croplands. Threshold concentration for inhibition of the activated sludge process is 0.1 mg/l, and for the nitrification process is 0.5 mg/l. In a study of 214 POTW, median pass through values were over 80 percent for primary plants and over 60 percent for trickling filter, activated sludge, and biological process plants. Lead concentration in POTW effluents ranged from 0.003 to 1.8 mg/l (means = 0.106 mg/l, standard deviation = 0.222).

Application of lead-containing sludge to cropland should not affect the uptake by crops under most conditions because normally lead is strongly bound by soil. However, under the unusual conditions of low pH (less than 5.5) and low concentrations of labile phosphorus, lead solubility is increased and plants can accumulate lead.

Nickel(124). Nickel is seldom found in nature as the pure elemental metal. It is a reltively plentiful element and is widely distributed throughout the earth's crust. It occurs in marine organisms and is found in the oceans. The chief commercial ores for nickel are pentlandite [$(Fe,Ni)_9S_8$], and a lateritic ore consisting of hydrated nickel-iron-magnesium silicate.

Nickel has many and varied uses. It is used in alloys and as the pure metal. Nickel salts are used for electroplating baths.

The toxicity of nickel to man is thought to be very low, and systemic poisoning of human beings by nickel or nickel salts is almost unknown. In nonhuman mammals nickel acts to inhibit insulin release, depress growth, and reduce cholesterol. A high incidence of cancer of the lung and nose has been reported in humans engaged in the refining of nickel.

Nickel salts can kill fish at very low concentrations. However, nickel has been found to be less toxic to some fish than copper, zinc, and iron. Nickel is present in coastal and open ocean water at concentrations in the range of 0.0001 to 0.006 mg/l although the most common values are 0.002 - 0.003 mg/l. Marine animals contain up to 0.4 mg/l and marine plants contain up to 3 mg/l. Higher nickel concentrations have been reported to cause reduction in photosynthetic activity of the giant kelp. A low concentration was found to kill oyster eggs.

For the protection of human health based on the toxic properties of nickel ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 0.134 mg/l. If contaminated aquatic organisms are consumed, excluding consumption of water, the ambient water criterion is determined to be 1.01 mg/l. Available data show that adverse effects on aquatic life occur for total recoverable nickel concentrations as low as 0.032 mg/l.

Nickel is not destroyed when treated in a POTW, but will either pass through to the POTW effluent or be retained in the POTW sludge. It can interfere with POTW treatment processes and can also limit the usefulness of municipal sludge.

Nickel salts have caused inhibition of the biochemical oxidation of sewage in a POTW. In a pilot plant, slug doses of nickel significantly reduced normal treatment efficiencies for a few hours, but the plant acclimated itself somewhat to the slug dosage and appeared to achieve normal treatment efficiencies within 40 hours. It has been reported that the anaerobic digestion process is inhibited only by high concentrations of nickel, while a low concentration of nickel inhibits the nitrification process.

The influent concentration of nickel to POTW facilities has been observed by the EPA to range from 0.01 to 3.19 mg/l, with a median of 0.33 mg/l. In a study of 190 POTW, nickel pass-through was greater than 90 percent for 82 percent of the primary plants. Median pass-through for trickling filter, activated sludge, and biological process plants was greater than 80 percent. POTW effuent concentrations ranged from 0.002 to 40 mg/l (mean = 0.410, standard deviation = 3.279).

Nickel not passed through the POTW will be incorporated into the sludge. In a recent two-year study of eight cities, four of the cities had median nickel concentrations of over 350 mg/kg, and two were over 1,000 mg/kg. The maximum nickel concentration observed was 4,010 mg/kg.

Nickel is found in nearly all soils, plants, and waters. Nickel has no known essential function in plants. In soils, nickel typically is found in the range from 10 to 100 mg/kg. Various environmental exposures to nickel appear to correlate with increased incidence of tumors in man. For example, cancer in the maxillary antrum of snuff users may result from using plant material grown on soil high in nickel.

Nickel toxicity may develop in plants from application of sewage sludge on acid soils. Nickel has caused reduction of yields for a variety of crops including oats, mustard, turnips, and cabbage. In one study nickel decreased the yields of oats significantly at 100 mg/kg.

Whether nickel exerts a toxic effect on plants depends on several soil factors, the amount of nickel applied, and the contents of other metals in the sludge. Unlike copper and zinc, which are more available from inorganic sources than from sludge, nickel uptake by plants seems to be promoted by the presence of the organic matter in sludge. Soil treatments, such as liming reduce the solubility of nickel. Toxicity of nickel to plants is enhanced in acidic soils.

Selenium(125). Selenium (chemical symbol Se) is a nonmetallic element existing in several allotropic forms. Gray selenium, which has a metallic appearance, is the stable form at ordinary temperatures and melts at 220°C. Selenium is a major component of 38 minerals and a minor component of 37 others found in various parts of the world. Most selenium is obtained as a by-product of precious metals recovery from electrolytic copper refinery slimes. U.S. annual production at one time reached one million pounds.

Principal uses of selenium are in semi-conductors, pigments, decoloring of glass, zerography, and metallurgy. It also is used to produce ruby glass used in signal lights. Several selenium compounds are important oxidizing agents in the synthesis of organic chemicals and drug products.

While results of some studies suggest that selenium may be an essential element in human nutrition, the toxic effects of selenium in humans are well established. Lassitude, loss of hair, discoloration and loss of fingernails are symptoms of selenium poisoning. In a fatal case of ingestion of a larger dose of selenium acid, peripheral vascular collapse, pulumonary edema, and coma occurred. Selenium produces mutagenic and teratogenic effects, but it has not been established as exhibiting carcinogenic activity.

For the protection of human health from the toxic properties of selenium ingested through water and through contaminated aquatic organisms, the ambient water criterion is determind to be 0.010 mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than that cited for human toxicity.

Very few data are available regarding the behavior of selenium in POTW. One EPA survey of 103 POTW revealed one POTW using biological treatment and having selenium in the influent. Influent concentration was 0.0025 mg/l, effluent concentration was 0.0016 mg/l giving a removal of 37 percent. It is not known to be inhibitory to POTW processes. In another study, sludge from POTW in 16 cities was found to contain from 1.8 to 8.7 mg/kg selenium, compared to 0.01 to 2 mg/kg in untreated soil. These concentrations of selenium in sludge present a potential hazard for humans or other mammuals eating crops grown on soil treated with selenium containing sludge.

Silver(126). Silver is a soft, lustrous, white metal that is insoluble in water and alkali. In nature, silver is found in the elemental state (native silver) and combined in ores such as argentite ($Ag_2S$), horn silver (AgCl), proustite ($Ag_3AsS_3$), and pyrargyrite ($Ag_3SbS_3$). Silver is used extensively in several industries, among them electroplating.

Metallic silver is not considered to be toxic, but most of its salts are toxic to a large number of organisms. Upon ingestion by humans, many silver salts are absorbed in the circulatory system and deposited in various body tissues, resulting in generalized or sometimes localized gray pigmentation of the skin and mucous membranes know as argyria. There is no known method for removing silver from the tissues once it is deposited, and the effect is cumulative.

Silver is recognized as a bactericide and doses from $1 \times 10^{-6}$ to $5 \times 10^{-4}$ mg/l have been reported as sufficient to sterilize water. The ambient water criterion to protect human health from the toxic properties of silver ingested through water and through contaminated aquatic organisms is 0.05 mg/l. Available data show that adverse effects on aquatic life occur at total recoverable silver concentrations as low as 1.2 x $10^{-3}$ mg/l.

The chronic toxic effects of silver on the aquatic environment have not been given as much attention as many other heavy metals. Data from existing literature support the fact that silver is very toxic to aquatic organisms. Despite the fact that silver is nearly the most toxic of the heavy metals, there are insufficient data to adequately evaluate even the effects of hardness on silver toxicity. There are no data available on the toxicity of different forms of silver.

There is no available literature on the incidental removal of silver by POTW. An incidental removal of about 50 percent is assumed as being representative. This is the highest average incidental removal of any metal for which data are available. (Copper has been indicated to have a median incidental removal rate of 49 percent).

Bioaccumulation and concentration of silver from sewage sludge has not been studied to any great degree. There is some indication that silver could be bioaccumulated in mushrooms to the extent that there could be adverse physiological effects on humans if they consumed large quantites of mushrooms grown in silver enriched soil. The effect, however, would tend to be unpleasnat rather than fatal.

There is little summary data available on the quantity of silver discharged to POTW. Presumably there would be a tendency to limit its discharge from a manufacturing facility because of its high intrinsic value.

Thallium (127). Thallium (Tl) is a soft, silver-white, dense, malleable metal. Five major minerals contain 15 to 85 percent thallium, but they are not of commerical importance because the metal is produced in sufficient quantity as a by-product of lead-zinc smelting of sulfide ores. Thallium melts at 304°C. U.S. annual production of thallium and its compounds is estimated to be 1500 lb.

Industrial uses of thallium include the manufacture of alloys, electronic devices and special glass. Thallium catalysts are used for industrial organic syntheses.

Acute thallium poisoning in humans has been widely described. Gastrointestinal pains and diarrhea are followed by abnormal sensation in the legs and arms, dizziness, and, later, loss of hair. The central nervous system is also affected. Somnolence, delerium or coma may occur. Studies on the teratogenicity of thallium appear inconclusive; no studies on mutagenicity were found; and no published reports on carcinogenicity of thallium were found.

For the protection of human health from the toxic properties of thallium ingested through water and contaminated aquatic organisms, the ambient water criterion is 1.34 x $10^{-2}$ mg/l. If contaminated aquatic organisms alone are consumed, excluding consumption of water, the ambient water criterion is determined to be 48 mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

No reports were found regarding the behavior of thallium in POTW. It will not be degraded, therefore it must pass through to the effluent or be removed with the sludge. However since the sulfide (TlS) is very insoluble, if appreciable sulfide is present dissolved thallium in the influent to POTW may be precipitated into the sludge. Subsequent use of sludge bearing thallium compounds as a soil amendment to crop bearing soils may result in uptake of this element by food plants. Several leafy garden crops (cabbage, lettuce, leek, and endive) exhibit relatively higher concentrations of thallium than other foods such as meat.

Zinc(128). Zinc occurs abundantly in the earth's crust, concentrated in ores. It is readily refined into the pure, stable, silvery-white metal. In addition to its use in alloys, zinc is used as a protective coating on steel. It is applied by hot dipping (i.e. dipping the steel in molten zinc) or by electroplating.

Zinc can have an adverse effect on man and animals at high concentrations. Zinc at concentrations in excess of 5 mg/l causes an undesirable taste and odor which persists through conventional treatment. For the prevention of adverse effects due to these organoleptic properties of zinc, concentrations in ambient water should not exceed 5 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.047 mg/l.

Toxic concentrations of zinc compounds cause adverse changes in the morphology and physiology of fish. Lethal concentrations in the range of 0.1 mg/l have been reported. Acutely toxic concentrations induce cellular breakdown of the gills, and possibly the clogging of the gills with mucous. Chronically toxic concentrations of zinc compounds cause general enfeeblement and widespread histological changes to many organs, but not to gills. Abnormal swimming behavior has been reported at 0.04 mg/l. Growth and maturation are retarded by zinc. It has been observed that the effects of zinc poisoning may not become apparent immediately, so that fish removed from zinc-contaminated water may die as long as 48 hours after removal.

In general, salmonoids are most sensitive to elemental zinc in soft water; the rainbow trout is the most sensitive in hard waters. A complex relationship exists between zinc concentration, dissolved zinc concentration, pH, temperature, and calcium and magnesium concentration. Prediction of harmful effects has been less than reliable and controlled studies have not been extensively documented.

The major concern with zinc compounds in marine waters is not with acute lethal effects, but rather with the long-term sublethal effects of the metallic compounds and complexes. Zinc accumulates in some marine species, and marine animals contain zinc in the range of 6 to 1500 mg/kg. From the point of view of acute lethal effects, invertebrate marine animals seem to be the most sensitive organism tested.

Toxicities of zinc in nutrient solutions have been demonstrated for a number of plants. A variety of fresh water plants tested manifested harmful symptoms at concentrations of 10 mg/l. Zinc sulfate has also been found to be lethal to many plants and it could impair agricultural uses of the water.

Zinc is not destroyed when treated by POTW, but will either pass through to the POTW effluent or be retained in the POTW sludge. It can interfere with treatment processes in the POTW and can also limit the usefuleness of municipal sludge.

In slug doses, and particularly in the presence of copper, dissolved zinc can interfere with or seriously disrupt the operation of POTW biological processes by reducing overall removal efficiencies, largely as a result of the toxicity of the metal to biological organisms. However, zinc solids in the form of hydroxides or sulfides do not appear to interfere with biological treatment processes, on the basis of available data. Such solids accumulate in the sludge.

The influent concentrations of zinc to POTW facilities have been observed by the EPA to range from 0.017 to 3.91 mg/l, with a median concentration of 0.33 mg/l. Primary treatment is not efficient in removing zinc; however, the microbial floc of secondary treatment readily adsorbs zinc.

In a study of 258 POTW, the median pass-through values were 70 to 88 percent for primary plants, 50 to 60 percent for trickling filter and biological process plants, and 30-40 percent for activated process plants. POTW effluent concentrations of zinc ranged from 0.003 to 3.6 mg/l (mean = 0.330, standard deviation = 0.464).

The zinc which does not pass through the POTW is retained in the sludge. The presence of zinc in sludge may limit its use on cropland. Sewage sludge contains 72 to over 30,000 mg/kg of zinc, with 3,366 mg/kg as the mean value. These concentrations are significantly greater than those normally found in soil, which range from 0 to 195 mg/kg, with 94 mg/kg being a common level. Therefore, application of sewage sludge to soil will generally increase the concentration of zinc in the soil. Zinc can be toxic to plants, depending upon soil pH. Lettuce, tomatoes, turnips, mustard, kale, and beets are especially sensitive to zinc contamination.

Xylene (130). Xylene ($C_6H_4(CH_3)_2$) is a colorless flammable liquid with a density of 0.86 g/ml. The boiling point ranges from 137 to 140°C, and the flash point is 29°C. Xylene is practically insoluble in water, but it is miscible with alcohol, ether, and many other organic liquids. Xylene is commonly a mixture of three isomers, ortho, meta, and para-xylene, with m-xylene predominating. Xylene is manufactured from pseudocumene, or by catalytic isomerization of a hydrocarbon fraction.

Xylene is predominately used as a solvent, for the manufacture of dyes and other organics, and as a raw material for production of benzoic acid, phthalic anhydride and other acids and esters used in the manufacture of polyester fibers.

Xylene has been shown to have a narcotic effect on humans exposed to high concentrations. The chronic toxicity of xylene has not been defined, however, it is less toxic than benzene.

Data on the behavior of xylene in POTW are not available. However, the methyl groups in xylene tend to transfer electrons to the benzene ring and make it more susceptible to biochemical oxidation. This observation in addition to the low water solubility of xylene, leads to the expectation that aeration processes will remove some xylene from the POTW.

Aluminum. Aluminum is a nonconventional pollutant. It is a silvery white metal, very abundant in the earths crust (8.1%), but never found free in nature. Its principal ore is bauxite. Alumina ($Al_2O_3$) is extracted from the bauxite and dissolved in molten cryolite. Aluminum is produced by electrolysis of this melt.

Aluminum is light, malleable, ductile, possesses high thermal and electrical conductivity, and is non-magnetic. It can be formed, machined or cast. Although aluminum is very reactive, it forms a protective oxide film on the surface which prevents corrosion under many conditions. In contact with other metals in presence of moisture the protective film is destroyed and voluminous white corrosion products form. Strong acids and strong alkali also break down the protective film. Aluminum is one of the principal basis metals used in the coil coating industry.

Aluminum is nontoxic and its salts are used as coagulants in water treatment. Although some aluminum salts are soluble, alkaline conditions cause precipitation of the aluminum as a hydroxide.

Aluminum is commonly used in cooking utensils. There are no reported adverse physiological effects on man from low concentrations of aluminum in drinking water.

Aluminum does not have any adverse effects on POTW operation at any concentrations normally encountered.

Ammonia. Ammonia (chemical formula $NH_3$) is a non-conventional pollutant. It is a colorless gas with a very pungent odor, detectable at concentrations of 20 ppm in air by the nose, and is very soluble in water (570 gm/l at 25°C). Ammonia is produced industrially in very large quantities (nearly 20 millions tons annually in the U.S.). It is converted to ammonium compounds or shipped in the liquid form (it liquifies at -33°C). Ammonia also results from natural processes. Bacterial action on nitrates or nitrites, as well as dead plant and animal tissue and animal wastes produces ammonia. Typical domestic wastewaters contain 12 to 50 mg/l ammonia.

The principal use of ammonia and its compounds is as fertilizer. High amounts are introduced into soils and the water runoff from agricultural land by this use. Smaller quantities of ammonia are used as a refrigerant. Aqueous ammonia (2 to 5 percent solution) is widely used as a household cleaner. Ammonium compounds find a variety of uses in various industries.

Ammonia is toxic to humans by inhalation of the gas or ingestion of aqueous solutions. The ionized form ($NH_4^+$) is less toxic than the un-ionized form. Ingestion of as little as one ounce of household ammonia has been reported as a fatal dose. Whether inhaled or ingested, ammonia acts distructively on mucous membrane with resulting loss of function. Aside from breaks in liquid ammonia refrigeration equipment, industrial hazard from ammonia exists where solutions of ammonium compounds may be accidently treated with a strong alkali, releasing ammonia gas. As little as 150 ppm ammonia in air is reported to cause laryngeal spasm, and inhalation of 5000 ppm in air is considered sufficient to result in death.

Freshwater ambient water criteria for total ammonia are pH and temperature dependent; un-ionized ammonia criteria is 0.02 mg/l. The reported odor threshold for ammonia in water is 0.037 mg/l. Un-ionized ammonia is acutely or chronically toxic to many important freshwater and marine aquatic organisms at ambient water concentrations below 4.2 mg/l. Salmonoid fishes are especially sensitive to the toxic effects of un-ionized ammonia at concentrations as low as 0.025 mg/l during prolonged exposure. Because the proportion of un-ionized ammonia varies with environmental conditions and cannot be directly controlled in the ambient water, total ammonia is the pollutant which must be controlled.

The behavior of ammonia in POTW is well documented because it is a natural component of domestic wastewaters. Only very high concentrations of ammonia compounds could overload POTWs. One study has shown that concentrations of un-ionized ammonia greater than 90 mg/l reduce gasification in anaerobic digesters and concentrations of 140 mg/l stop digestion competely. Corrosion of copper piping and excessive consumption of chlorine also result from high ammonia concentrations. Interference with aerobic nitrification processes can occur when large concentrations of ammonia suppress dissolved oxygen. Nitrites are then produced instead of nitrates. Elevated nitrite concentrations in drinking water are known to cause infant methemoglobinemia.

Fluoride. Fluoride ion ($F^-$) is a nonconventional pollutant. Fluorine is an extremely reactive, pale yellow, gas which is never found free in nature. Compounds of fluorine - fluorides - are found widely distributed in nature. The principal minerals containing fluorine are fluorspar ($CaF_2$) and cryolite ($Na_3AlF_6$). Although fluorine is produced commercially in small quantities by electrolysis of potassium bifluoride in anhydrous hydrogen fluoride, the elemental form bears little relation to the combined ion. Total production of fluoride chemicals in the U.S. is difficult to estimate because of the varied uses. Large volume usage compounds are: Calcium fluoride (est. 1,500,000 tons in U.S.) and sodium fluoroaluminate (est. 100,000 tons in U.S.). Some fluoride compounds and their uses are: sodium fluoroaluminate - aluminum production; calcium fluoride - steelmaking, hydrofluoric acid production, enamel, iron foundry; boron trifluoride - organic synthesis; antimony pentafluoride - fluorocarbon production; fluoboric acid and fluoborates - electroplating; perchloryl fluoride ($ClO_3F$) - rocket fuel oxidizer; hydrogen fluoride - organic fluoride manufacture, pickling acid in stainless steelmaking, manufacture of alumium fluoride; sulfur hexafluoride - insulator in high voltage transformers; polytetrafluoroethylene - inert plastic. Sodium fluoride is used at a concentration of about 1 ppm in many public drinking water supplies to prevent tooth decay in children.

The toxic effects of fluoride on humans include severe gastroenteritis, vomiting diarrhea, spasms, weakness, thirst, failing pulse and delayed blood coagulation. Most observations of toxic effects are made on individuals who intentionally or accidentally ingest sodium fluoride intended for use as rat poison or insecticide. Lethal doses for adults are estimated to be as low as 2.5 g. At 1.5 ppm in drinking water, mottling of tooth enamel is reported, and 14 ppm, consumed over a period of years, may lead to deposition of calcium fluoride in bone and tendons.

Very few data are available on the behavior of fluoride in POTW. Under usual operating conditions in POTW, fluorides pass through into the effluent. Very little of the fluoride entering conventional primary and secondary treatment processes is removed. In one study of POTW influents conducted by the U.S. EPA, nine POTW reported concentrations of fluoride ranging from 0.7 mg/l to 1.2 mg/l, which is the range of concentrations used for fluoridated drinking water.

Iron. Iron is a nonconventional polluant. It is an abundant metal found at many places in the earth's crust. The most common iron ore is hematite ($Fe_2O_3$) from which iron is obtained by reduction with carbon. Other forms of commercial ores are magnetite ($Fe_3O_4$) and taconite (FeSiO). Pure iron is not often found in commercial use, but it is usually alloyed with other metals and minerals. The most common of these is carbon.

Iron is the basic element in the production of steel. Iron with carbon is used for casting of major parts of machines and it can be machined, cast, formed, and welded. Ferrous iron is used in paints, while powdered iron can be sintered and used in powder metallurgy. Iron compounds are also used to precipitate other metals and undesirable minerals from industrial wastewater streams.

Corrosion products of iron in water cause staining of porcelain fixtures, and ferric iron combines with tannin to produce a dark violet color. The presence of excessive iron in water discourages cows from drinking and thus reduces milk production. High concentrations of ferric and ferrous ions in water kill most fish introduced to the solution within a few hours. The killing action is attributed to coatings of iron hydroxide precipitates on the gills. Iron oxidizing bacteria are dependent on iron in water for growth. These bacteria form slimes that can affect the aesthetic values of bodies of water and cause stoppage of flows in pipes.

Iron is an essential nutrient and micro-nutrient for all forms of growth. Drinking water standards in the U.S. set a limit of 0.3 mg/l of iron in domestic water supplies based on aesthetic and organoleptic properties of iron in water.

High concentrations of iron do not pass through a POTW into the effluent. In some POTW iron salts are added to coagulate precipitates and suspended sediments into a sludge. In an EPA study of POTW the concentration of iron in the effluent of 22 biological POTW meeting secondary treatment performance levels ranged from 0.048 to 0.569 mg/l with a median value of 0.25 mg/l. This represented removals of 76 to 97 percent with a median of 87 percent removal.

Iron in sewage sludge spread on land used for agricultural purposes is not expected to have a detrimental effect on crops grown on the land.

Phenols(Total). "Total Phenols" is a nonconventional pollutant parameter. Total phenols is the result of analysis using the 4-AAP (4-aminoantipyrene) method. This analytical procedure measures the color development of reaction products between 4-AAP and some phenols. The results are reported as phenol. Thus "total phenol" is not total phenols because many phenols (notably nitrophenols) do not react. Also, since each reacting phenol contributes to the color development to a different degree, and each phenol has a molecular weight different from others and from phenol itself, analyses of several mixtures containing the same total concentration in mg/l of several phenols will give different numbers depending on the proportions in the particular mixture.

Despite these limitations of the analytical method, total phenols is a useful analysis when the mix of phenols is relatively constant and an inexpensive monitoring method is desired. In any given plant or even in an industry subcategory, monitoring of "total phenols" provides an indication of the concentration of this group of toxic pollutants as well as those phenols not selected as toxic pollutants. A further advantage is that the method is widely used in water quality determinations.

In an EPA survey of 103 POTW the concentration of "total phenols" ranged grom 0.0001 mg/l to 0.176 mg/l in the influent, with a median concentration of 0.016 mg/l. Analysis of effluents from 22 of these same POTW which had biological treatment meeting secondary treatment performance levels showed "total phenols" concentrations ranging from 0 mg/l to 0.203 mg/l with a median of 0.007. Removals were 64 to 100 percent with a median of 78 percent.

It must be recognized, however, that six of the eleven toxic pollutant phenols could be present in high concentrations and not be detected.

Conversely, it is possible, but not probable, to have a high "total phenol" concentration without any phenol itself or any of the ten other toxic pollutant phenols present. A characterization of the phenol mixture to be monitored to establish constancy of composition will allow "total phenols" to be used with confidence.

Oil and Grease. Oil and grease are taken together as one pollutant parameter. This is a conventional polluant and some of its components are:

1. Light Hydrocarbons - These include light fuels such as gasoline, kerosene, and jet fuel, and miscellaneous sol- vents used for industrial processing, degreasing, or cleaning purposes. The presence of these light hydro- carbons may make the removal of other heavier oil wastes more difficult.

2. Heavy Hydrocarbons, Fuels, and Tars - These include the crude oils, diesel oils, #6 fuel oil, residual oils, slop oils, and in some cases, asphalt and road tar.

3. Lubricants and Cutting Fluids - These generally fall in- to two classes: nonemulsifiable oils such as lubrica- ting oils and greases and emulsifiable oils such as water soluble oils, rolling oils, cutting oils, and draw- ing compounds. Emulsifiable oils may contain fat soap or various other additives.

4. Vegetable and Animal Fats and Oils - These originate primarily from processing of foods and natural products.

These compounds can settle or float and may exist as solids or liquids depending upon factors such as method of use, production process, and temperature of wastewater.

Oil and grease even in small quantities cause troublesome taste and odor problems. Scum lines from these agents are produced on water treatment basin walls and other containers. Fish and water fowl are adversely affected by oils in their habitat. Oil emulsions may adhere to the gills of fish causing suffocation, and the flesh of fish is tainted when microorganisms that were exposed to waste oil are eaten. Deposition of oil in the bottom sediments of water can serve to inhibit normal benthic growth. Oil and grease exhibit an oxygen demand.

Many of the organic priority pollutants will be found distributed between the oily phase and the aqueous phase in industrial wastewaters. The presence of phenols, PCBs, PAHs, and almost any other organic pollutant in the oil and grease make characterization of this parameter almost impossible. However, all of these other organics add to the objectionable nature of the oil and grease.

Levels of oil and grease which are toxic to aquatic organisms vary greatly, depending on the type and the species susceptibility. However, it has been reported that crude oil in concentrations as low as 0.3 mg/l is extremely toxic to fresh-water fish. It has been recommended that public water supply sources be essentially free from oil and grease.

Oil and grease in quantities of 100 l/sq km show up as a sheen on the surface of a body of water. The presence of oil slicks decreases the aesthetic value of a waterway.

Oil and grease is compatible with a POTW activated sludge process in limited quantity. However, slug loadings or high concentrations of oil and grease interfere with biological treatment processes. The oils coat surfaces and solid particles, preventing access of oxygen, and sealing in some microorganisms. Land spreading of POTW sludge containing oil and grease uncontaminated by toxic pollutants is not expected to affect crops grown on the treated land, or animals eating those crops.

pH. Although not a specific pollutant, pH is related to the acidity or alkalinity of a wastewater stream. It is not, however, a measure of either. The term pH is used to describe the hydrogen ion concentration (or activity) present in a given solution. Values for pH range from 0 to 14, and these numbers are the negative logarithms of the hydrogen ion concentrations. A pH of 7 indicates neutrality. Solutions with a pH above 7 are alkaline, while those solutions with a pH below 7 are acidic. The relationship of pH and acidity and alkalinity is not necessarily linear or direct. Knowledge of the water pH is useful in determining necessary measures for corroison control, sanitation, and disinfection. Its value is also necessary in the treatment of industrial wastewaters to determine amounts of chemcials required to remove pollutants and to measure their effectiveness. Removal of pollutants, especially dissolved solids is affected by the pH of the wastewater.

Waters with a pH below 6.0 are corrosive to water works structures, distribution lines, and household plumbing fixtures and can thus add constituents to drinking water such as iron, copper, zinc, cadmium, and lead. The hydrogen ion concentration can affect the taste of the water and at a low pH, water tastes sour. The bactericidal effect of chlorine is weakened as the pH increases, and it is advantageous to keep the pH close to 7.0. This is significant for providng safe drinking water.

Extremes of pH or rapid pH changes can exert stress conditions or kill aquatic life outright. Even moderate changes from acceptable criteria limits of pH are deleterious to some species. The relative toxicity to aquatic life of many materials is increased by changes in the water pH. For example, metallocyanide complexes can increase a thousand-fold in toxicity with a drop of 1.5 pH units.

Because of the universal nature of pH and its effect on water quality and treatment, it is selected as a pollutant parameter for many industry categories. A neutral pH range (approximately 6-9) is generally desired because either extreme beyond this range has a deleterious effect on receiving waters or the pollutant nature of other wastewater constituents.

Pretreatment for regulation of pH is covered by the "General Pretreatment Regulations for Exisiting and New Sources of Pollution," 40 CFR 403.5. This section prohibits the discharge to a POTW of "pollutants which will cause corrosive structural damage to the POTW but in no case discharges with pH lower than 5.0 unless the works is specially designed to accommodate such discharges."

Sulfides. Sulfides are constituents of many industrial wastes such as those from tanners, paper mills, chemical plants, and gas works; but they are also generated in sewage and some natural waters by the anerobic decomposition of organic matter. When added to water, soluble sulfide salts such as $Na_2S$ dissociate into sulfide ions which in turn react with the hydrogen ions in the water to form HS- or $H_2S$, the proportion of each depending upon the resulting pH value.

Due to the unpleasant taste and odor which exist when sulfides are present in water, it is unlikely that any person or animal would consume a harmful dose. The threshold level of taste and smell are reported to be 0.2 mg/l of sulfides in pump-mill wastes. For industrial uses, however, even small traces of sulfides are often detrimental.

The toxicity of sulfide solutions toward fish increases as the pH value is lowered, i.e., the $H_2S$ or HS- appears to be the principle toxic agent. Experiments with trout substantiate this statement. However, inorganic sulfides have also proved fatal to trout at concentrations between 0.5 and 1.0 mg/l as sulfide, even in neutral and somewhat alkaline solutions.

Tin. Tin is a silver-white, lustrous and malleable metal with a density of 7.31 g/ml. The melting point of tin is 231.9°C while the boiling point is 2507°C.

Tin is used chiefly for tin-plating, soldering alloys and babbitt type metals.

Tin is not present in natural waters but it may occur in industrial wastes. Tin salts therefore, may reach surface waters or groundwater; but because many of the salts are insoluble in water, it is unlikely that much of the tin will remain in solution or suspension. No reports have been uncovered to indicate that tin can be detrimental in domestic water supplies.

Rats have tolerated 25 mg or more of sodium stannuous tartrate in the diet over a period of 4-12 months without ill effects. Similar tests with other animals had similar results - no ill effects. On the basis of these feeding experiments, it is unlikely that any concentration of tin that could occur in water would be detrimental to livestock.

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It is apparent that trace concentrations of tin are beneficial to fish. However, higher levels have proved fatal to eels which were tested.

Total Suspended Solids(TSS). Suspended solids include both organic and inorganic materials. The inorganic compounds include sand, silt, and clay. The organic fraction includes such materials as grease, oil, tar, and animal and vegetable waste products. These solids may settle out rapidly, and bottom deposits are often a mixture of both organic and inorganic solids. Solids may be suspended in water for a time and then settle to the bed of the stream or lake. These solids discharged with man's wastes may be inert, slowly biodegradable materials, or rapidly decomposable substances. While in suspension, suspended solids increase the turbidity of the water, reduce light penetration, and impair the photosynthetic activity of aquatic plants.

Supended solids in water interfere with many industrial processes and cause foaming in boilers and incrustastions on equipment exposed to such water, especially as the temperature rises. They are undesirable in process water used in the manufacture of steel, in the textile industry, in laundries, in dyeing, and in cooling systems.

Solids in suspension are aesthetically displeasing. When they settle to form sludge deposits on the stream or lake bed, they are often damaging to the life in the water. Solids, when transformed to sludge deposit, may do a variety of damaging things, including blanketing the stream or lake bed and thereby destroying the living spaces for those benthic organisms that would otherwise occupy the habitat. When of an organic nature, solids use a portion or all of the dissolved oxygen available in the area. Organic materials also serve as a food source for sludgeworms and associated organisms.

Disregarding any toxic effect attributable to substances leached out by water, suspended solids may kill fish and shellfish by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids are inimical to aquatic life because they screen out light, and they promote and maintain the development of noxious conditions through oxygen depletion. This results in the killing of fish and fish food organisms. Suspended solids also reduce the recreational value of the water.

Total suspended solids is a traditional pollutant which is compatible with a well-run POTW. This pollutant with the exception of those components which are described elsewhere in this section, e.g., heavy metal components, does not interfere with the operation of a POTW. However, since a considerable portion of the innocuous TSS may be inseparably bound to the constituents which do interfere with POTW operation, or produce unusable sludge, or subsequently dissolve to produce unacceptable POTW effluent, TSS may be considered a toxic waste hazard.

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